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# MAXIMUM PC

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Future

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MAXIMUM PC
REFRESH YOUR PC!

**On the Cover**
Illustration by
Martina Morawetz

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MAXIMUM PC

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Gordon
Mah Ung

# WRITTEN ON A PC

**THIS MAY SURPRISE** you, but I wrote this column on a PC. In fact, everything I've written for the magazine this month was written on a—wait for it—PC.

Other things I've used a PC for this month: editing photos, editing audio, burning DVDs and audio CDs (yes, I still use those), and transcoding video. Oh, and I played games on my PC, too. I also accessed the Internet and wrote 95 percent of my emails this month on a PC.

I'm not going on here because I've finally run out of things to say. I'm mentioning this because maybe the problem with the PC today is that we don't have the equivalent of the "sent from one of my four iPads" email appendage tacked onto our every communiqué.

Said appendages are not the choice of the tablet or phone buyer, of course. Those signatures are set by default by the device maker so that any time you get an email from someone using a phone or tablet, you are informed of the sender's device choice. Sure, it's possible to edit or even delete the offending text, but few users ever bother. I suspect that many enjoy the cachet associated with their specific device.

When an email is sent from a PC, though, there is no device-maker message appended. It usually has your contact info, maybe a funny or inspirational line, and that's it. Well, guess what, world? People are using their PCs to send email, too. In fact, I'd bet that the actual word-volume of PC-generated email is higher than mobile-generated. Sure, there's probably more email sent on phones or tablets today, but those are just one- or four-word responses, while people compose far longer emails on a PC.

The world doesn't run on just email, though. It runs on images, video, and office documents. It runs on Javascript, C++, DirectX, HTML, Flash, and all kinds of nifty languages and APIs—all created on a PC. By now, I'm sure you're sick of me getting in your face telling you that at this very moment, I'm using my PC to create a magazine, too (full disclosure: *Maximum PC* is actually laid out in Adobe Indesign by our Art Director Richard Koscher on an x86-based desktop system booting an alternative operating system. In other words, a PC), but I think it's OK.

If the world actually knew how much was created on the PC—from the pictures they see to the videos they watch on Youtube to the paychecks they cash—they'd realize just how integral the PC is to our world. No? You disagree. Too much in your face and confrontational. Really? If someone doesn't mind sending out email with the signature saying it was "sent from my phone," they probably won't mind me telling them for ten minutes all the things I did on my PC today, too.

*Gordon Mah Ung is Maximum PC's deputy editor, senior hardware expert, and all-around muckraker.*

↘ submit your questions to: comments@maximumpc.com

# THE NEWS

## Comcast Disturbs the Force

### Media giant offers $45 billion for Time-Warner Cable and demands tribute from Netflix

**BY ALL ACCOUNTS**, Comcast Corporation is the largest mass media and communications company in the world, by revenue.

Bigger than Rupert Murdoch's News Corp empire; bigger than Disney, which also owns Pixar, Marvel, and Lucasfilm; and bigger than Viacom, which owns Paramount and seemingly half the channels on basic cable. Part of this is thanks to Comcast's $13.7 billion acquisition of NBC Universal in 2011, and now it appears that NBCU was just one step on a longer journey.

The next step is the acquisition of its nearest cable TV competitor, Time Warner Cable. TWC (which Time Warner, Inc. spun off as an independent company in 2009) serves more than 11 million customers. By comparison, Comcast serves 21.7 million, according to the *New York Times*. At about 33 million, their combined customer base would dwarf the population of Texas.

And in the midst of this, Comcast wants Netflix to start paying to use its series of tubes. The company is apparently not eager to win any popularity contests. It mounted NBC's peacock on the hood of its corporation, in case there was any doubt as to ownership. And it's been a regular finalist in the Consumerist's annual "Worst Company in America" awards. The quality of Netflix's service had been degrading for months, but things reached a critical level right around the time that the federal courts struck down net neutrality, on the basis that the FCC did not have the authority to regulate information services. Net neutrality is intended to preserve equal access to whatever services you ask to be delivered to you over the Internet. Without legal enforcement or regional competition, proponents say, things can get ugly. Once you start paying the ISP to reach its customers, you set a precedent for a future where *only* those who can pay the ISP will have any visibility, they say.

Are proponents of net neutrality being too harsh, though? Telecom analyst Jeff Kagan believes so. Kagan is in favor of Comcast charging Netflix.

"I have read many who think this is not good for the end user," Kagan said. "I see this story as more for the two companies and the economics of the industry, and less for the consumer."

However, things got a bit unclear when Mr. Kagan said that Netflix would no longer be paying the Internet transit provider middlemen to deliver traffic to Netflix.

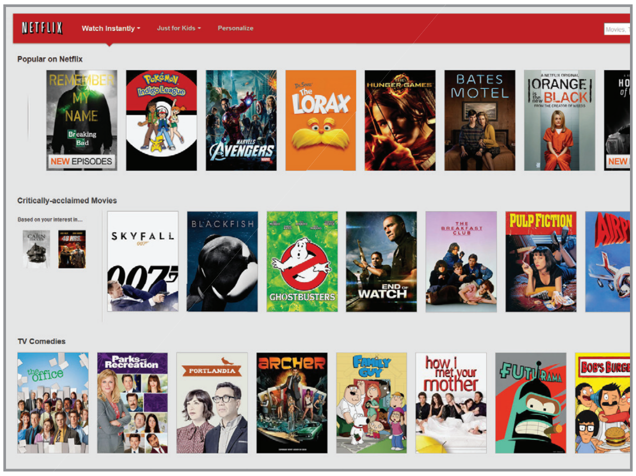
"After this deal, Netflix will pay Comcast and stop paying others for delivery to Comcast," Kagan maintained. "Netflix will still pay others to deliver to other providers like Time Warner Cable, Cox... and so on."

We're not sure how Cogent, Level 3, and others would be compensated in this new system, but technology analyst Rob Enderle believes it will blow up for Comcast.

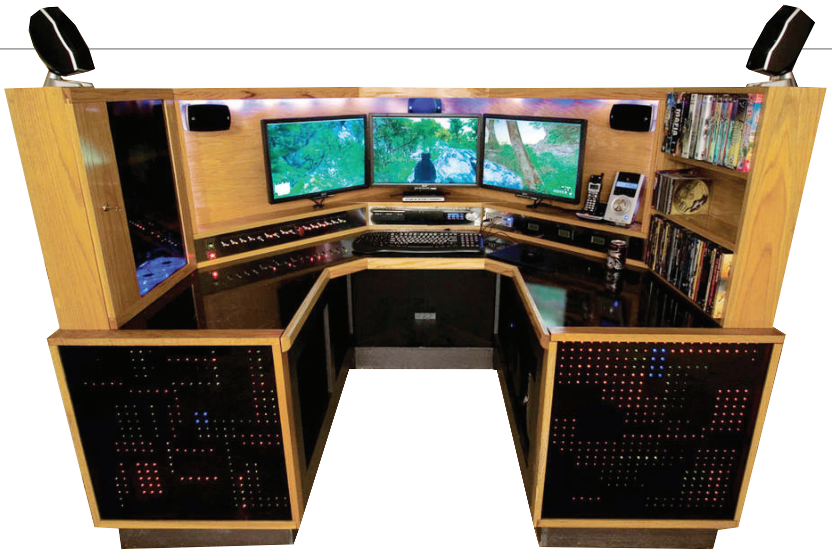
"This will be a self-correcting problem, because increasingly, the power is moving to the content owners. But by acquiring Time Warner, Comcast gets enough power to push back rather hard on both the legislation and this content trend," Enderle said. "If they use that power, then the content owners and Google are likely to move around them, making the deal suicidal strategically for Comcast. It will give Comcast enough rope to hurt consumers, and that rope will likely eventually strangle Comcast."

Although the FCC can't regulate Comcast like it does a telecom, it can still review and potentially block a Comcast-TWC merger (as it did in 2011 with AT&T and T-Mobile), so this story isn't over yet.

**—Tom McNamara**



**Netflix's content directly competes with cable TV companies that provide Internet access—awkward!**



## Rig of the Month is Online

Until a few years ago, we had a section in our magazine called Rig of the Month. Readers would send in photos of fancy or just plain whimsical boxes, and a lucky few would be featured in each issue. Well, we've decided to do an online resurrection of this section, at our website: http://bit.ly/MPC_ROTM. That link will show you how to contact us, provide a gallery of past winners, and list some helpful tips on how to take good photos. (Don't shoot with a potato, seek out natural lighting, clean up your PC and the area around it, and Gordon says that he will throw an intern into a volcano if it's a Mac.) **–TM**

## Asus to Double PC Shipments

You may have heard some industry experts claim that the desktop PC is dead and being rapidly replaced by tablets and even smartphones. Well, hardware manufacturer Asus isn't buying it. Company president Jerry Shen announced that it planned to ship about four million desktop PCs in 2014, up from two million last year; China would be "one of the company's major targets," in recognition of its large population and steadily growing middle class. For comparison, Lenovo shipped about 14 million desktop and laptop PCs last year, and Dell about 9.5 million, according to research firm Gartner; the firm expects about 321 million PC shipments in 2014, which follows several quarters of double-digit decline. **–PL**

## LaCie Unveils 5TB Drives

Solid-state drives may be super-fast, but they're also super-expensive compared to a mechanical drive, and no consumer SSD is currently bigger than 1 terabyte. Right now, you can get a 4TB hard drive for as low as $150. Up until recently, though, that was the biggest you could find anywhere. Now, French storage-device company LaCie has announced the arrival of several external devices containing 5TB hard drives—from its new owner Seagate. At the top end is a unit containing five of these, giving you five more TBs than previous five-disk setups could supply. LaCie's new units will come in USB 3.0 and Thunderbolt II varieties. The single-drive version has a launch price of $450, so you probably won't be putting it in grandma's Youtube machine. **–PL**

*Continuted on page 12*

Tom
Halfhill
**Fast**
**Forward**

# WHEN COMPATIBLE ISN'T COMPATIBLE

**EVERYONE WHO'S SAVVY** enough to read this magazine is probably the first-call tech support for friends and family. But what about the people who *write* this magazine? Do we ever resort to calling a vendor's tech support?

You betcha. At least, I do. I could claim I'm investigating the support that newbies get, but the truth is, sometimes I'm stumped. Most recently, it happened while trying to make a Windows 8 recovery disk for a new Hewlett-Packard notebook.

Like most small notebooks, my HP has no optical drive and didn't come with Windows install discs. No problem, I thought. HP's Recovery Manager can use the recovery partition on the hard drive to create the recovery media on DVDs (using an external drive) or on a USB thumb drive. I chose the thumb drive, because it seemed easier than burning six DVDs. The recovery files required at least 23GB, so I bought a new SanDisk 32GB drive. The package logo assured me the product is "Windows 8 Compatible."

Hours later, despite flashing lights indicating continuous disk activity, a check revealed that no files were actually copied. I eliminated all the likely possibilities before finally calling HP's tech support. A nice woman in Bangalore diagnosed the problem: my new thumb drive is Windows 8 compatible. Windows 8 automatically mounts a compatible thumb drive as a *local* drive, but the Recovery Manager requires a *removable* drive. No error message told me this, of course.

Ms. Bangalore advised using a drive that isn't "Windows 8 compatible" so that it would be compatible. But all my older, incompatible thumb drives were smaller than 32GB, so they weren't compatible with my requirements, either. After consulting a supervisor, Ms. Bangalore cheerfully agreed to mail me a bootable thumb drive with the recovery files preinstalled—no charge.

Problem solved! But, still.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report.*

Thomas McDonald

**Game Theory**

# FROM CHAOS, ORDER

**I'VE ALWAYS** known that if I covered technology long enough, I'd encounter something I don't understand. It's taken 25 years, but the moment's here: I don't understand Twitch.

I get the tech and all that, mind you. I just cannot fathom the idea of thousands upon thousands of people watching someone else play games for hours on end. It was like stumbling upon a community of waffle porn aficionados or people who think Lena Dunham is funny.

"Twitch Plays Pokemon" seemed to take Twitch in a new and even more ridiculous direction. While the first game was still in progress, I popped in from time to time to see a flurry of contradictory orders being entered into an online Pokemon Red emulator. This massive community of gamers input conflicting commands as the character (literally!) twitched across the screen, attempting to complete something like an action.

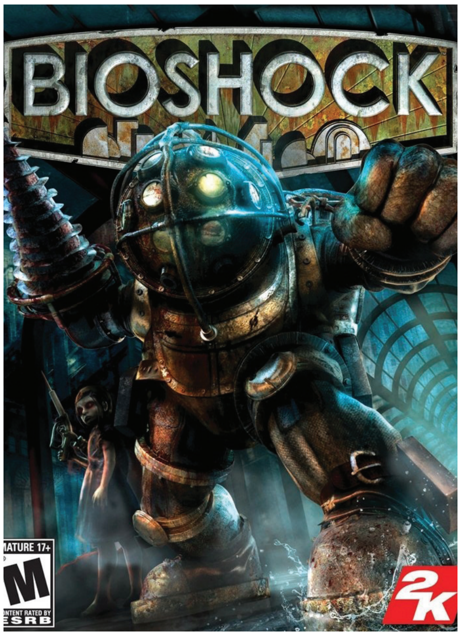
It was absurd. It was chaos. It was filled with griefers attempting to walk the character off a cliff or constantly hitting the start button.

And then something really strange happened. Out of all this chaos, something like order began to arise. It was helped along by some tweaks to the code to prevent the start menu problems. People began to work together. They began to plan. Anarchy mode (in which each command is entered instantly) gave way to Democracy mode (in which the most popular commands in a 30 second period are used), with people voting which mode to use once an hour.

What appeared to be an absurd gimmick turned into a fascinating social experiment powered by a game. People attempting to actually play the game were fighting on two fronts: the game itself and the trolls determined to wreak havoc.

In the midst of all this, a kind of ragged ersatz community formed. Gamers began to plan. It was an unexpected, amazing illustration of spontaneous order—the very heart of democracy and free markets. Thus, a Pokemon emulator and a chat window becomes an experiment illustrating how civilizations form.

Thomas L. McDonald is Editor-at-Large of *Games Magazine*.



## Irrational Games Shuts Its Doors

Ken Levine announced in an open letter that his 17-year-old Irrational Games studio was closing, and he that would retain a core team of about 15 people. Indications were that its most recent game, BioShock Infinite, did not meet financial expectations. According to an unnamed source in the *New York Times*, the game cost $200 million to develop and market, which Levine disputed in a Twitter post. In the letter, Levine said he desired a studio with "a flatter structure and a more direct relationship with gamers." His new team will be making "narrative-driven games for the core gamer that are highly replayable." **–TM**

## Toshiba Announces Warp-Speed USB Flash Drive

Despite living in an age where even your cat expects you to be putting data in "the cloud," portable storage still has its uses. However, the smaller these devices get, the slower they tend to be. Hardware manufacturer Toshiba is bucking this trend with a USB 3.0 flash drive called the TransMemory Pro, which claims read and write speeds of over 200MB/s. Its bundled EX II Pad Locker allows you to create a hidden partition on the drive, and there are options for encryption and password protection, too. The TransMemory Pro comes in just 64GB and 128GB capacities at launch, with MSRPs of $130 and $200, respectively. It's compatible with USB 2.0 but will be limited to that protocol's max of 480Mb/s **–PL**

## Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

### TRIUMPHS

**RIG OF THE MONTH**
That's right, we're bringing it back! At least in online form, for now. ∂Baby steps.

**NINE CITIES**
That will possibly be receiving Google Fiber. Meanwhile, the *Maximum PC* staff is stuck with Comcast.

**ANDROID**
Android now owns 62 percent of the tablet market, and grew a crazy 127 percent in 2013.

### TRAGEDIES

**RADIO SHACK**
It announced it is closing 1,100 stores. Stock up on speaker cable and RJ-45 connectors!

**WINDOWS XP**
As of April 8th, Windows XP will be officially retired after more than 12 years. We loved you, man.

**MTGOX**
Crypto currency exchange files for bankruptcy after $450 million BitCoin stolen. Seems legit.

Quinn
Norton
**Byte
Rights**

# IT'S BAD-TREATY KILLIN' TIME

**THE TRANS** Pacific Partnership, or TPP, is an evil trade agreement being negotiated in secret by twelve nations. The only reason we know much at all about it is that the intellectual property chapter was leaked to Wikileaks back in November.

The leaked text revealed TPP to be a super-DMCA, granting the power to prosecute and censor for rights-holding corporations. It creates controls on culture straight out of the now-dead ACTA and SOPA. It provides more protections for patents to benefit pharmaceuticals companies, increasing the power of a patent system so broken that it makes the innovation it was designed to protect a constant hazard of life-crushing liability.

The TPP is being negotiated in secret, so secret that our own congressional committees meant to provide oversight for the USTR can't see the text, while companies like Halliburton and movie studios have both access and input.

But this is all old news. I've whined to you about all of this for years. What is new is the rising protest in those twelve nations against the trade representatives' obvious attempt to screw the Internet and public in general. Like COICA, SOPA, PIPA, and ACTA before it, the TPP is suffering from the fact that everyone hates it and wants it to die—everyone but the Obama administration and the corporations it represents.

Right now, the administration is trying to fast track congressional approval in order to get the TPP into law before anyone has a chance to see how awful it is. That means it's political go-time again, and it's going to take another upwelling of public hate to stop this newest terrible attempt to destroy our nets and our rights. It's becoming a routine, the public against the net haters, but it's a routine we keep winning. So, call your representatives, sign petitions, hit the streets, and kill this thing.

Quinn Norton writes about copyright for Wired News and other publications.

## AMD's Mantle Stirs Competition

Late last year, CPU- and GPU-maker AMD announced Mantle, a new API that could replace Microsoft's DirectX in future games. AMD used flagship title Battlefield 4 to demonstrate performance gains from 5 percent to 20 percent, depending on the video card (all of which need to have AMD's "GCN" architecture to be compatible, at least for now). The secondary implication was that Mantle could make a game look nicer without impacting performance.

Several months before this, an AMD exec claimed that Microsoft was not actively developing DirectX anymore. Microsoft denied it but did not elaborate. With the Games Developer Conference in March, however, Microsoft announced DirectX 12 and declared its intent to deliver on key features associated with Mantle, such as more direct communication with the hardware, and less reliance on the CPU. When you throw in the fact that Mantle is cross-platform (Windows, Linux, Mac), you can see why Microsoft might be a bit nervous. Studios currently integrating Mantle into games include BioWare, Criterion, DICE, PopCap, and Eidos.

OpenGL is the major pre-existing cross-platform API, and the Khronos Group, which guides its development, had some words on the subject, as well. At GDC, it brought together high-level technicians from AMD, Intel, and Nvidia to talk about optimizations to OpenGL that it claimed could reduce driver overhead (which reduces performance and battery life) by a factor of ten. However, it said that these alterations were already available in the programming code and provided some demos as visual aid. **–TM**

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EA

## Hackers Target 300K Routers

Tech site Ars Technica reported that more than 300,000 home networks had been compromised due to exploited flaws in routers made by D-Link, TP-Link, Micronet, and others. This flaw could be used to secretly redirect the user to fake bank websites used to steal account information, or to put malicious software on their computers. Security firm Team Cymru first discovered the flaw and reported it to the general public. If your router is compatible with DD-WRT, reports indicated that it would be more resistant to these attacks than the pre-installed proprietary firmware. Disabling remote access to your router can also help (and is the default setting in most of these devices). **–TM**

## 128GB MicroSD Card Arrives

If your mobile device only has a MicroSD card slot for external storage, and you need more than 64GB of space, you're in luck. SanDisk has introduced the world's first 128GB MicroSD card, featuring up to 30MB/s read speed. (No word on write speed, but don't expect it to be nearly as fast, if history is any guide.) But with an MSRP of $200, it's not for the faint of heart. It says it uses a proprietary vertical stacking technique to pack all of those memory chips into such a small space. At launch, the item was exclusive to Amazon and Best Buy. **–PL**

# THE LIST

## 8 DYING TECHNOLOGIES YOUTHS DON'T USE

### 8 LAND LINES

Nobody wants to pay for two phone contracts or sit on the couch to talk.

CANON ZOOM LENS 8x IS
5.0-40.0mm 1:3.2-6.9
8× OPTICAL ZOOM

### 7 COMPACT CAMERA

There's no reason to carry one of these instead of a smartphone, and phones are higher-res.

### 6 CDS

Vinyl records are making a comeback, but the 30-year-old compact disc isn't and never will.

SONY
8:30
DREAM MACHINE

### 5 ALARM CLOCK

Once again, the smartphone has claimed another victim—the snooze button.

### 4 ANSWERING MACHINE

We're not sure if youths actually call anymore, let alone leave voicemails.

DeTeWe
Message 400
DETEWE HOTLINE
Ein/Aus
Neue Nachricht
Ansage
Nachrichten/Stop
Menü
Löschen
Memo
Clip
Vol

### 3 WIRED INTERNET

We'll never give up our LAN cables, but these damned kids are all about wireless now.

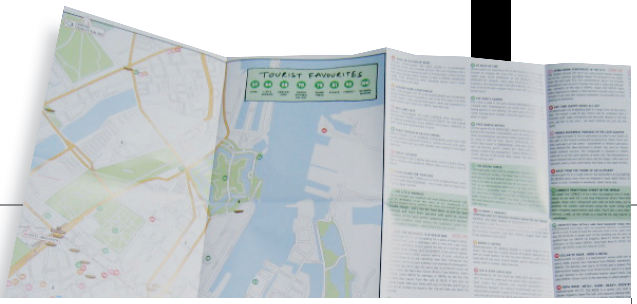
### 2 GPS DEVICE

Smartphones now handle GPS duties, rendering the dashboard-mounted box obsolete.

0.2 mi
Exit 40A: Ninth St (Sta
64
Arrival
4:09 PM
Speed
45

### 1 MAPS

Our parents still use them, but today's youth will never unfold one of these in the car.


TOURIST FAVOURITES

# HEAD TO

BY GORDON MAH UNG

# Surface RT vs. Chromebook

We'll be honest—no one on our staff would choose a tablet or Chromebook as his or her primary portable over a full-featured laptop. Yet, we can't deny that Google's Chrombooks have been wildly successful sellers. The proper platform to put against Chromebooks? Surface RT. Yes, Microsoft's original hybrid device that marked a break from x86, and one that people thought would be a game-changer. It wasn't, but the Surface RT is still around and is now competitively priced at $300. That, folks, is Chromebook range, and makes it the perfect combatant to get into this slap fight.

The Acer C720 is the best deal in Chromebooks, and a worthy competitor to the Surface RT.

## ROUND 1

### Capability

Chrome OS is possibly the most limited operating system in town today. With a traditional "fat OS" such as Windows, OSX, or even Android, you can install local applications that run on the device. Chrome OS is pretty much a cloud laptop with almost everything running through a browser. That means no "real" fat apps and just about nothing when you have no access to the Internet. Likewise, Surface RT is also hobbled by its lack of support for "legacy" Windows apps. You simply cannot take advantage of the millions of x86 apps out there, since it runs on the ARM architecture. However, even Microsoft's anemic Modern UI app store gives you more offline capability than Chrome OS, plus the Surface gives you a free copy of Office 2013 RT that runs perfectly fine without an Internet connection.

**Winner:**
**Surface RT**

## ROUND 2

### Price

Chromebooks got off to a pretty slow and head-scratching start when they were first introduced, with prices that were almost equal to traditional budget notebooks and netbooks with a "real OS" on them. Chromebooks didn't really start to burn up the sales charts until they broke the magic $300 barrier. Today, you can get a very capable Chromebook for $200, and you'd have a hard time finding a Chromebook for more than $350. The debut price of the Surface RT was also a real Whiskey Tango Foxtrot at $500—without a keyboard. Today, the Surface RT (which is still available) has been recalibrated down to $300 without a keyboard and $350 or $400 with one, depending on the keyboard. In the Surface RT's corner, you also get Office 2013 RT, which is not a cheap option on its own for the x86 version. Still, you'd have to work to spend $300 on a Chromebook.

**Winner:**
**Chromebook**

# HEAD

Believe it or not, Surface RT is still available as a new product, now at a very palatable price.

## ROUND 3

### Build Quality

We are fortunate in that in our time in The Lab, we've actually touched or tested about 90 percent of the Chromebook models ever sold. In all that time, besides Google's odd-duck $1,300 Chromebook Pixel, we've never been blown away by the build quality. They are, for the most part, ultra-budget notebooks and they feel like it. However, in the Chromebooks' defense, they all at least feature full-size keyboards. The Surface RT, on the other hand, was originally made as a premium tablet/laptop hybrid device and it feels like it. There's a nice heft and solid feel to the Surface RT that isn't there in the Chromebooks. The only negative in build quality is the barely there Type Cover keyboard—but it can easily be swapped out for the far better Type Cover. The Surface RT also features an IPS panel and has touch in its corner, most Chromebooks have neither.

**Winner:**
**Surface RT**

## ROUND 4

### Battery Life and Performance

This one is a bit tough to judge, as there are so many Chromebooks to choose from for the comparison. You can pick from anemic ARMs to Haswell-based Celerons, so it really can be all over the map as far as performance and battery life are concerned. We've seen everything from all-(work)day browsing performance to meh, depending on the make and model. Surface RT is also an interesting kettle of fish, with its Tegra 3 ARM chip. In performance, it's actually slower than a dual-core Atom chip. If we have to sum it up, though, we'll give the Chromebook the advantage, as you can get a Haswell-Celeron-based Chromebook from several major OEMs, and they pound both Surface RT and the newer (and twice as expensive) Surface 2 in performance and battery life.

**Winner:**
**Chromebook**

## ROUND 5

### Security

In terms of security, it's pretty hard to do better than a Chromebook today. It's Linux-based, so it's way, way more secure than any Windows OS, right? Not so fast. When it comes to Windows, you probably can't get more secure than Windows RT today. While malware-targeting Windows 8 won't work because it's Windows RT, frankly, RT sales are so insignificant that no hacker would waste time targeting it. There are other aspects to security, though. Nothing is stored on your Chromebook. If confiscated at the border, you lose nothing. Anything on the Surface could be compromised, and you'd lose the files, of course. Chromebooks aren't immune from attack, though, as they rely on the strength of the security of your Internet connection. Overall, both are actually very secure and safer than other desktop OSes today. We'll give the overall nod to the Chromebook, though, because you can't steal what's not there.

**Winner:**
**Chromebook**

## And the Winner Is...

We actually thought this would be easier when we started. After all, Surface RT is pretty much on the outs, and when you have the aura of a loser, it's hard to overcome that. When we actually sat down and thought hard about this comparison, it was a lot closer than we expected. Surface RT has a lot more appeal at $300 than it did at $550. Still, we have to give this battle to **Chromebooks**. This might be different if we were looking at, say, a Windows 8.1 hybrid at $400 with the x86 library and power behind it, but it isn't. Maybe you'll see that battle in a future issue. ⏻

# DOCTOR

THIS MONTH THE DOCTOR TACKLES...

## > Dual Dual-Boot Questions
## > Ancient Computers
## > Router Confusion

### Dual Boot 7 and Linux

I am a bit of a newbie, but 76 years old. Can a Windows user install both Windows 7 and a Linux distro on a solid-state drive—particularly a Samsung 840 EVO drive?

**—Charles Greenwood**

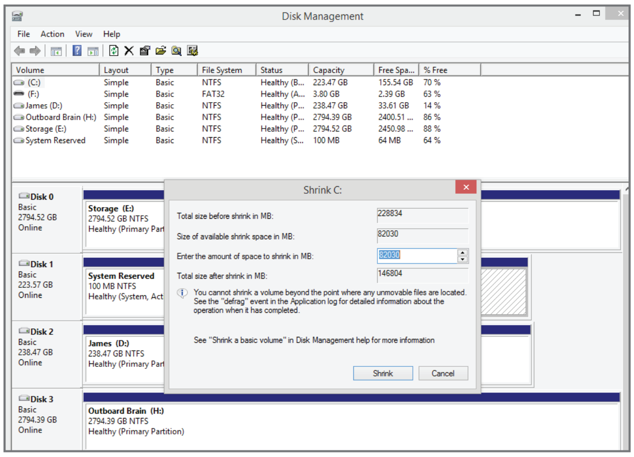
**THE DOCTOR RESPONDS:** Yes, you can install both Windows and Linux onto the same SSD, just as you would on a mechanical drive, provided the drive is large enough to accommodate both operating systems. The Doc would recommend at least a 256GB drive, if not larger. The best way to do this is to install Windows first, then install your Linux distro. Ubuntu makes this particularly easy, as its install process allows you to install it side-by-side with Windows, and guides you through the process of shrinking your Windows partition to make room for Ubuntu. If you want to shrink your Windows partition from within Windows, see the next Doctor question. See this help page for details: http://bit.ly/MPC_WinDB.

If you're not planning to install Ubuntu or one of its variants, the procedure will be slightly different, but the answer is the same: Yes, as long as there's room, and install Windows first because its bootloader doesn't play nicely with Linux if Linux is on the drive first.

### Dual-boot 7 and 8

I have Windows 7 Ultimate 64-bit and Windows 8 Pro 64-bit. I'd like to have both installed on my system and choose between them when I boot up. I don't really like Win 8 and really do like Win 7. I have a 128GB Samsung 840 Pro SSD with about 16TB of other hard drives. I am looking to upgrade to a 256GB drive so that I can better run both OSes on. I am hoping you might be able to give me proper instructions as to how to have a dual-system boot on my system.

**—David Dube**



| Volume | Layout | Type | File System | Status | Capacity | Free Spa... | % Free |
|---|---|---|---|---|---|---|---|
| (C:) | Simple | Basic | NTFS | Healthy (B... | 223.47 GB | 155.54 GB | 70 % |
| (F:) | Simple | Basic | FAT32 | Healthy (A... | 3.80 GB | 2.39 GB | 63 % |
| James (D:) | Simple | Basic | NTFS | Healthy (P... | 238.47 GB | 33.61 GB | 14 % |
| Outboard Brain (H:) | Simple | Basic | NTFS | Healthy (P... | 2794.39 GB | 2400.51 ... | 86 % |
| Storage (E:) | Simple | Basic | NTFS | Healthy (P... | 2794.52 GB | 2450.98 ... | 88 % |
| System Reserved | Simple | Basic | NTFS | Healthy (S... | 100 MB | 64 MB | 64 % |

Disk 0
Basic
2794.52 GB
Online

Storage (E:)
2794.52 GB NTFS
Healthy (Primary Part

Disk 1
Basic
223.57 GB
Online

System Reserved
100 MB NTFS
Healthy (System, Act

Disk 2
Basic
238.47 GB
Online

James (D:)
238.47 GB NTFS
Healthy (Primary Part

Disk 3
Basic
2794.39 GB
Online

Outboard Brain (H:)
2794.39 GB NTFS
Healthy (Primary Partition)

Total size before shrink in MB: 228834
Size of available shrink space in MB: 82030
Enter the amount of space to shrink in MB: 82030
Total size after shrink in MB: 146804

You cannot shrink a volume beyond the point where any unmovable files are located. See the "defrag" event in the Application log for detailed information about the operation when it has completed.

See "Shrink a basic volume" in Disk Management help for more information

You can use Windows Disk Management to shrink full-disk partitions, enabling you to create another partition on the same drive.

**THE DOCTOR RESPONDS:** You can certainly dual-boot Windows 8 and 7, but the Doc thinks it's a waste of space, since you'll be using double the disk space to install nearly identical operating systems. The desktop portion of Windows 8 is virtually the same as Windows 7's, except better, and the annoying parts of Windows 8 can be minimized or turned off entirely via the use of Stardock's Start8 and ModernMix.

Anyway, assuming your mind is made up, the best way is to install Windows 7 first, making sure to only use half of the free space on the drive for your Win 7 partition. If you accidentally use the whole thing, no problem. Once Windows 7 is installed, go into Disk Management (right-click on My Computer, select Manage, and go to Storage > Disk Management), right-click the C partition, and select Shrink Partition. Resize it so that about half the space on your drive is free. It's best to do this right after installing Windows 7, of course, so you have free space on the drive. Leave the newly created free space as unallocated space; don't put another partition there. Then, shut down your computer and boot from the Windows 8 install media. The Doc is assuming that you bought the physical media or were able to create a bootable flash drive or DVD from the download tool.

When the installation wizard gets to the part where it asks "What kind of installation do you want?" select Custom, then choose the unallocated space on your drive, and the rest is a cinch. After it installs and you restart your computer, you should be able to choose which OS to boot into, and which one you boot into by default.

### Ancient Motherboard Problems

Doc, I'm having problems with my motherboard. I'm running an MSI K8N Neo4 with a dual-core AMD processor with

↘ submit your questions to: doctor@maximumpc.com

1GB of RAM and a 500-watt PSU. I'm trying to reinstall Windows XP. I started a clean install, but halfway through the computer just shuts off. The power light on the computer flashes on and off. I have to wait 15 minutes to restart. At first, I thought it was overheating, but it never gets over 29 C. I set the BIOS to not shut down on errors. I also swapped the video card to a smaller one that requires less power. Then, I thought it was the power supply, so I replaced that, but my PC still shuts off.

Finally, I started unplugging the power to the motherboard and plugging it back in. By doing this, I found that I could restart the computer right away. The solder and pegs of the power socket are intact. Do you have any ideas, or is the motherboard toast?

**—Darrel W**

**THE DOCTOR RESPONDS:** The Doc would take a good long look at any capacitors on the motherboard. If any of them are bulged out, it's quite possible you are a victim of bad caps. You can actually replace the cap yourself, but most people elect to move on. For those who don't know the ancient history, the electronics industry as a whole was a victim of sub-quality capacitors that urban lore claims was the result of one vendor using a stolen electrolytic formula. Basically, an unknown number of PCs, televisions, and all other sorts of electronic devices have failed due to bulged or bad caps. Vendors are so sensitive to this old issue that they all like to proclaim that they use military-grade capacitors made from unicorn horns in their motherboards. That MSI motherboard is a little late to be part of the bad caps era, but it's still possible.

If the Doc were in your shoes, he'd look for the next possible failure: inadequate cooling due to thermal paste that's disappeared. If the machine is roughly 10 years old, the thermal paste could be kaput, causing the machine to overheat and reboot. So, consider reseating the processor and reseating the heat sink with fresh thermal paste. You should also try removing one of the pieces of RAM (assuming you have two) and trying to reproduce the issue. Do so with both pieces of RAM. The last step may be to actually remove the motherboard from the case and see if it was installed incorrectly in the first place. Sometimes a poorly installed motherboard mount will short out the system. But in all likelihood, the board is bad. You should also know that Windows XP is at end-of-life status and will no longer receive updates from Microsoft. You should upgrade to a newer OS so that you can continue to receive security patches. The nForce 4 chipset on your board is also long dead as a supported product, so maybe you can accentuate the positive and use the opportunity to get something a little more fresh.

## Chronic Router Model 420

Your February 2014 802.11ac Router Buyer's Guide has me re-evaluating if I want to continue my subscription to your magazine. Do you folks have your lab in a state that has legalized marijuana? Reflected in the chart labeled AC Routers Compared, you show up to 419Mb/s throughput using the 802.11ac Asus router. This is really fantastic, but where did you get an Internet connection of, what, 500Mb/s? Did you generate that in a lab?

Since you did not state your download speed, I will assume it was around 500Mb/s. Who has Internet that fast? Now, if your chart had a statement showing these routers all have linear ratings, and that if you only get 50Mb/s you can divided 50/500 =.1 and then take the Asus router's speed of 180 Mb/s (in the bedroom at 10ft) and you can be assured that at a download speed of 50 Mb/s, your speed will be: 419 x .1 = 41.9 Mb/s for the 802.11 AC and 180 x .1 = 18 Mb/s for the 802.11N. That could turn this useless chart into a useful chart, if in fact there is a way to deduct these figures. As it stands now, it is absolutely useless crap.

If you want to publish a magazine that is helpful to the vast majority of the readers, then tailor it to some level of reality. Also, it might have been useful to add that at present, as far as I could find, there are NO Apple 802.11ac adapters on the market as of Feb 16, 2014. And finally, show router input (download speeds and from where) and output (upload speeds). Then add the nifty theoretical specifications for future possibilities.

**—Dave Shaff**

**THE DOCTOR RESPONDS:** Thanks for your feedback, Dave. While our state hasn't yet legalized marijuana, it's pretty easy to get a medical-usage card.

First of all, you're correct that broadband speeds in the United States are pretty dismal, and you don't need an 802.11ac router to get maximum performance from your broadband connection. But there are several things you've overlooked. The first is that we tested performance between the test laptop and a PC wired to the router's Ethernet jacks. The speed of the broadband Internet connection was not tested, precisely because Internet connection speed varies so widely.

Secondly, performance just doesn't scale down linearly like that, even if we were talking about download speeds from the Internet at large. You can't take the 419Mb/s the Asus router got on the Wireless-AC test, and the 180Mb/s it got on Wireless-N on the same computer in the same location, and just apply a linear reduction in the way you seem to think you can, even if you *are* working with a slow Internet connection.

The Doc has around a 30Mb/s connection at home, with an Asus RT-AC66U router. So, we ran SpeedTest a bunch of times, just for kicks. A desktop wired directly to the router's Gigabit switch got 28.48Mb/s down. A laptop with a dual-band Intel AC 7260 Wi-Fi card 15 feet from the router got 28.54Mb/s on its 5GHz AC connection, and 22Mb/s on the 2.4GHz N connection. There's no 50 percent linear reduction going from Wireless-AC to Wireless-N across the board. So, even if you have a relatively slow Internet connection, like most of the country, your router isn't going to bottleneck you at the rate you assumed from the chart. You'd have to have an *extremely* fast network connection before you started seeing your router limit your download or upload speeds.

Thirdly, the reason to get one of these fast routers (and the reason we test their PC-to-PC speeds, not download speeds) is for fast in-network transfers, like streaming HD video from a home server to an HTPC, or backups. But if you're not doing that, you're correct, you don't need to spend $200 on a router.

Finally, as far as Apple goes, the 2013 MacBook Airs and Pros have Wireless-AC built in, and have since last year. ⏻

**[SECOND OPINION]**

## PROFESSIONAL USE ONLY

In your reply to the question about disabling SkyDrive (Doctor, March 2014), you suggested the use of gpedit. There was no mention that gpedit is only available in professional and enterprise editions of Windows 8 and 8.1.

**—Mark Hammonds**

# REFRESH YOUR PC

## GIVE YOUR PC A CLEAN START

**BY MAXIMUM PC STAFF**

If you're reading this, it's highly likely that your PC is a fine-tuned piece of 64-bit technology, customized to the hilt and purring like a kitten with a belly full of formula. Yup, she's a beaut, and attacks your daily tasks like a Belgian Police Dog going after a fleeing perp. All is well in the world, until one day when you sit down, fire it up, and realize something is different. That extra bit of snap when programs open is missing, and encoding video seems to take longer than it used to. Even downloading files seems to require more patience than you're accustomed to exhibiting. It's at this very moment that you silently say to yourself, "What the F*CK???"

First things first—calm down, power user. Before you smash your rig with a hammer, pound on the keyboard, and decide to just nuke it from orbit, realize it's just a temporary slowdown and it happens to everyone, even *Maximum PC* editors. Over time, PCs get slower; it's just the nature of the beast. Don't fret, we're here to help by showing you how to give your PC a clean start. We'll walk you step-by-step through the cleaning process, showing you what you need to get 'er done, and if you find you can't resolve the problem, how to properly nuke it from orbit. We'll also detail—pun intended—physically cleaning your rig. Once you're finished, your PC will be noticeably perkier and everything will be right as rain. Now, drop the hammer, and let's get started.

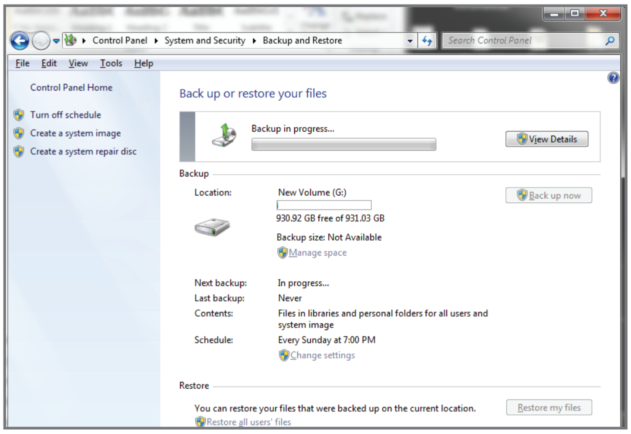
# BACK IT UP AND KICK THE TIRES

## The only person to blame for not having a backup is you

There's only two kinds of storage devices in this world: those that have already died and those that are going to die. If you've already identified that your PC is acting wonky, it's time to back that mother up. It may seem counterintuitive that you would run a backup before you do a PC cleanup, but we highly recommend it: If you break something or something finally gives up the ghost, you'll kiss your USB ports that you made a backup before it all went sideways. There are numerous aftermarket tools, but Microsoft has been kind enough to give you a fairly powerful backup and imaging tool in the OS itself. If you're using Windows 7, just search for Backup, or dig into the Control Panel and look under System and Security. If you're using Windows 8.x, the backup system is the same, although it's hidden. To find it, go to the Control Panel and search for Windows 7 File Recovery.

If you have multiple drives, you can choose how you want the backup to run, and manually select the other drives in the system for the backup set. You should set an automatic backup as well, and create a system restore disc. Ensure that you created a system image, also, should you need to restore the backup to a completely new hard drive.

With your backup complete, it's time to do a basic visual inspection of the internals of the PC for obvious problems, such as fans clogged with so much cat hair and dust that they're causing the CPU or GPU to overheat and throttle, or data or power cables that have wiggled loose. Typically, loose or unplugged cables result in immediate show-stopping errors and crashes rather than a system slowdown. You're more likely to find your fans clogged with dust running at low RPMs or fans that have died.



Back up or restore your files

Backup in progress...

Backup

Location: New Volume (G:)

930.92 GB free of 931.03 GB

Backup size: Not Available

Next backup: In progress...

Last backup: Never

Contents: Files in libraries and personal folders for all users and system image

Schedule: Every Sunday at 7:00 PM

Restore

You can restore your files that were backed up on the current location.

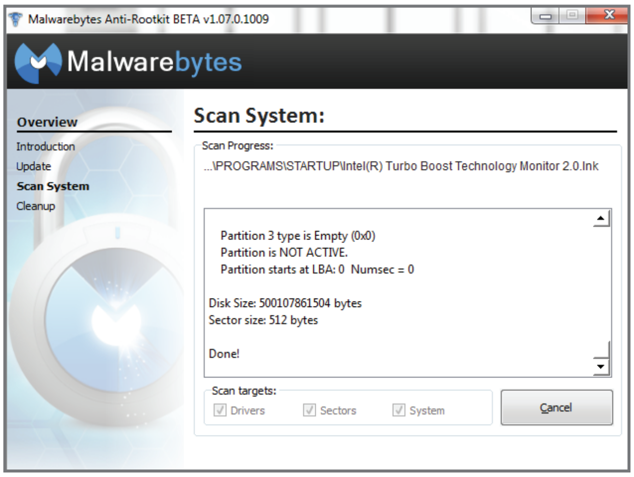
**The Windows backup and restore program works well enough, and should be run regularly.**

# MASH MALWARE

## Don't always blame malware, except when it's to blame

If there's a bogeyman of mysterious system slowdowns, it's malware. In fact, if we had a nickel for every time a relative told us a "virus" was the cause of their slowdown, we'd have $0.08^{-34}$ of a Bitcoin. With that said, before you get too hip-deep in trying to speedupify a PC, a sweep for malware should be run. We'd also do a cursory examination of the OS for extraneous toolbars or tray items that have been installed. These aren't truly malware, but still worthy of eradication.

We'd also recommend a full system scan by the system's real-time AV software (after updating the virus definitions). A secondary sweep using various on-demand tools is also on the to-do list. This would include browser-based file scanners available from all of the popular AV vendors, as well local tools such as Malwarebytes (www.malwarebytes.org) or SuperAntiSpyware (www.superantispyware.com). Running specific rootkit removal tools available from companies such as Malwarebytes and Sophos, among others, can't hurt. Rootkits are a class of malware designed to thwart normal detection means. Before you get crazy about removing any detections, you should research it to make sure it isn't just a false positive. And be advised that many types of malware can't be removed with a single-click tool. You'll typically have to dig deep in a multi-page guide to remove many of today's specialty infections. Obviously, Binging will lead you to most guides, but a great place to start is Bleepingcomputer.com. The site has loads of removal guides and links to useful tools. But again, a word of warning: don't just start ripping things out of the OS without knowing what you're removing.



Scan Progress:

...\PROGRAMS\STARTUP\Intel(R) Turbo Boost Technology Monitor 2.0.lnk

```
   Partition 3 type is Empty (0x0)
   Partition is NOT ACTIVE.
   Partition starts at LBA: 0  Numsec = 0

Disk Size: 500107861504 bytes
Sector size: 512 bytes

Done!
```

**A thorough check for malware is recommended before any serious system cleanup.**

Continuted on page 24

# CRUFT CLEARING

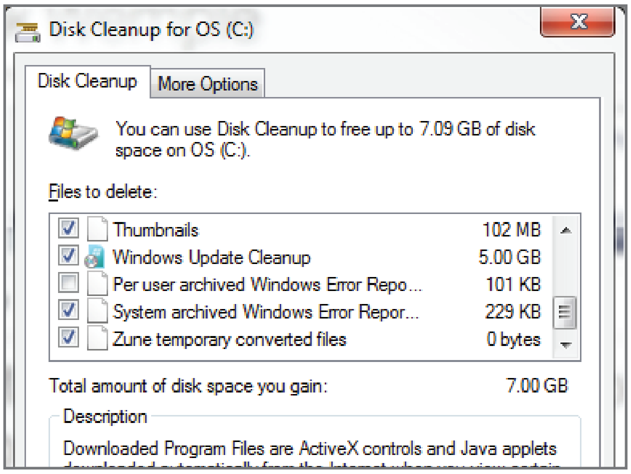
## Declutter the system files

Any PC that you use daily will build up hundreds of gigabytes of file clutter over the months and years that you use it. As most people are rolling large mechanical drives, the clutter has an impact on performance and your ability to pack away even more cute kitten videos downloaded from the Internet.

For this step, we'll start with the low-hanging fruit. Simply open My Computer, right-click your primary drive, and select properties. Click Disk Cleanup and check off the things that are clutter (just about everything is in this panel) and click OK. We did this on a work box and shaved off 7GB in Windows Update files that had been sitting around. While 7GB isn't much in the day of 4TB drives, many people still run 1TB and smaller drives with every nook, cranny, and sector filled (you know who you are.)

The next easy cruft targets are the system restore points automatically created by Windows. Windows typically creates these snapshots of the OS when you install a new driver, OS update, or application. Windows sets a default for these based on the size of the drive it's installed on, but they typically occupy gigabytes on the drive. To free up space, you can delete all but the latest restore points by clicking the More Options panel from Disk Cleanup, and selecting Clean Up under System Restore and Shadow Copies.

Before you do this, though, think about how the recent stability of your system. If it's been reliable but slow for the last few months, wiping the previous restore points should be fine. But if the system is being wonky, you may just need to rely on those restore points to get the box back to a point where it's stable, so we'd recommend keeping the old restore points until you're sure the box is working. You should also be aware that Windows 7 and Windows Vista used System Protection and Restore Points to occasionally make backup copies of your personal data files through the Volume Shadow Copies service. These older versions may be purged when you do this, but it won't touch your most recent versions.



You can use Disk Cleanup to free up to 7.09 GB of disk space on OS (C:).

Files to delete:

| | | |
|---|---|---|
| ☑ | Thumbnails | 102 MB |
| ☑ | Windows Update Cleanup | 5.00 GB |
| ☐ | Per user archived Windows Error Repo... | 101 KB |
| ☑ | System archived Windows Error Repor... | 229 KB |
| ☑ | Zune temporary converted files | 0 bytes |

Total amount of disk space you gain: 7.00 GB

Description

Downloaded Program Files are ActiveX controls and Java applets

**The built-in disk cleanup does a decent first pass at dumping unneeded system clutter.**

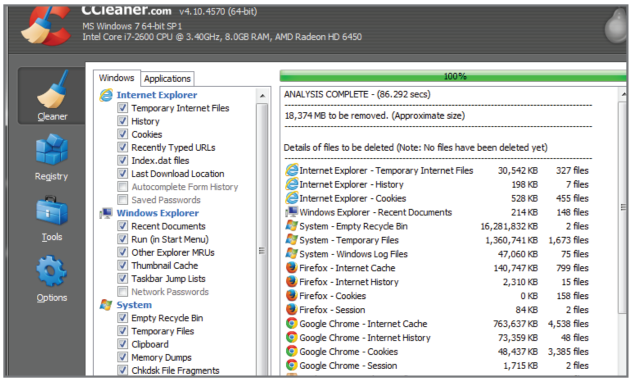
Yeah, we know, many power users will thumb their nose at System Restore and some will outright switch it off because malware can use it as a place to hide, but the feature can truly be a bacon-saver sometimes.

Another easy target to clean out is the default downloads folder. Other than documents, the vast majority of downloaded files can usually be dumped overboard.

# CLEAN THE CRAP

## CCleaner is an easy-to-use, one-stop declogger

Originally named Crap Cleaner, this handy application has since been renamed to the more palatable CCleaner, but it still works amazingly well at clearing out the junk from the corners of your OS. Available for free from http://bit.ly/MPC_CCleaner, it's an easy one-stop shop for freeing up space that you might normally miss with the built-in cleaner. As much as we like CCleaner, you shouldn't expect miracles. We ran it on three-year-old scungy build of Windows 7 after running the Window's cleaning routine and CCleaner came up with 18.3GB to clean out—16GB had accumulated in the trash bin. One word of warning: By default, CCleaner will wipe out your browser cookies, which might throw you for a loop when you're forced to sign into web sites that you may have forgotten the passwords for. It's probably best to exclude browser history and also Windows Explorer Recent Documents from the CCleaner clean-out, too, because they don't net you much space but make your system more livable.


CCleaner.com v4.10.4570 (64-bit)
MS Windows 7 64-bit SP1
Intel Core i7-2600 CPU @ 3.40GHz, 8.0GB RAM, AMD Radeon HD 6450
Cleaner
Registry
Tools
Options
Windows
Applications
100%

Internet Explorer
- ☑ Temporary Internet Files
- ☑ History
- ☑ Cookies
- ☑ Recently Typed URLs
- ☑ Index.dat files
- ☑ Last Download Location
- ☐ Autocomplete Form History
- ☐ Saved Passwords

Windows Explorer
- ☑ Recent Documents
- ☑ Run (in Start Menu)
- ☑ Other Explorer MRUs
- ☑ Thumbnail Cache
- ☑ Taskbar Jump Lists
- ☐ Network Passwords

System
- ☑ Empty Recycle Bin
- ☑ Temporary Files
- ☑ Clipboard
- ☑ Memory Dumps
- ☑ Chkdsk File Fragments

```
ANALYSIS COMPLETE - (86.292 secs)
--------------------------------------------------------------------
18,374 MB to be removed. (Approximate size)
--------------------------------------------------------------------

Details of files to be deleted (Note: No files have been deleted yet)
--------------------------------------------------------------------
Internet Explorer - Temporary Internet Files      30,542 KB    327 files
Internet Explorer - History                          198 KB      7 files
Internet Explorer - Cookies                          528 KB    455 files
Windows Explorer - Recent Documents                  214 KB    148 files
System - Empty Recycle Bin                    16,281,832 KB      2 files
System - Temporary Files                       1,360,741 KB  1,673 files
System - Windows Log Files                        47,060 KB     75 files
Firefox - Internet Cache                         140,747 KB    799 files
Firefox - Internet History                         2,310 KB     15 files
Firefox - Cookies                                      0 KB    158 files
Firefox - Session                                     84 KB      2 files
Google Chrome - Internet Cache                   763,637 KB  4,538 files
Google Chrome - Internet History                  73,359 KB     48 files
Google Chrome - Cookies                           48,437 KB  3,385 files
Google Chrome - Session                            1,715 KB      2 files
```

**CCleaner still does an admirable job of emptying out unneeded files.**

# STOP STARTUPS

## Giddyap quicker

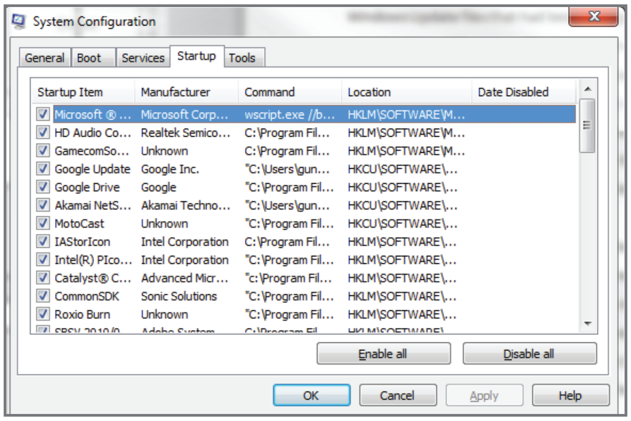
Oddly, many people still define their computing experience by how long it takes to cold-boot their PC. First, we just have to ask, have you tried standby or even hibernate? You know, those handy modes that can have you at the desktop five or 10 seconds after touching the mouse button or keyboard? No? You still prefer to boot from cold, anyway?

If your OS install is a year or two old, you will have accumulated enough startup programs to significantly impact hard-drive boot times. The easiest way to remove these programs is click on the Start button, and type **msconfig**. Click on the Startup tab and scroll through the list, looking for things that don't need to be started at launch. Uncheck them, click apply, then OK, and reboot.

One thing to remember, Windows 7 will optimize the boot times automatically. If you reboot, and wait five minutes and reboot four or five times, the boot times should actually get better automatically as Windows 7 decides what it can prioritize.

Windows 8.x (yes, haters, step back) actually improves upon boot times, as well. Anyone who has used the new OS can attest to its fast boot times. Win8 moves startup optimization to the Task Manager (ctrl-shift-esc). Click on the Startup tab, and Windows 8 will even tell you what's slowing things down, and give you an estimate of how long it took to boot after the process was handed over to the OS.

Those of us who have moved on to the SSD-based western shores of Valinor live lives fairly well untroubled by slow startups.



| Startup Item | Manufacturer | Command | Location | Date Disabled |
|---|---|---|---|---|
| ☑ Microsoft ® ... | Microsoft Corp... | wscript.exe //b... | HKLM\SOFTWARE\M... | |
| ☑ HD Audio Co... | Realtek Semico... | C:\Program Fil... | HKLM\SOFTWARE\M... | |
| ☑ GamecomSo... | Unknown | C:\Program Fil... | HKLM\SOFTWARE\M... | |
| ☑ Google Update | Google Inc. | "C:\Users\gun... | HKCU\SOFTWARE\... | |
| ☑ Google Drive | Google | "C:\Program Fil... | HKCU\SOFTWARE\... | |
| ☑ Akamai NetS... | Akamai Techno... | "C:\Users\gun... | HKCU\SOFTWARE\... | |
| ☑ MotoCast | Unknown | "C:\Program Fil... | HKCU\SOFTWARE\... | |
| ☑ IAStorIcon | Intel Corporation | C:\Program Fil... | HKLM\SOFTWARE\... | |
| ☑ Intel(R) PIco... | Intel Corporation | "C:\Program Fil... | HKLM\SOFTWARE\... | |
| ☑ Catalyst® C... | Advanced Micr... | "c:\Program Fil... | HKLM\SOFTWARE\... | |
| ☑ CommonSDK | Sonic Solutions | "C:\Program Fil... | HKLM\SOFTWARE\... | |
| ☑ Roxio Burn | Unknown | "C:\Program Fil... | HKLM\SOFTWARE\... | |

**You can manually deselect programs that start up from msconfig to speedify your boots.**

But those poor souls of middle earth still using mechanical-based drives are the ones who need to concern themselves with startup optimization. However, we can all benefit from storage-drive optimization, which we cover on page 32.

# CONSIDER AN UPGRADE

## Hardware isn't always the answer, but it usually is

The vast majority of our tips to clean up a slow-running PC can be solved in software, but sometimes software isn't the answer. How will you know the difference? One of the clearest indicators is age. Old PC components do not age like wine. If you're at your buddy's house to "take a look at his computer" and that computer is a Pentium 4 or Athlon XP, it's a lost cause.

So, while most newbs you're trying to help can still benefit from the cleaning tips in this story, the P4/Athlon XP machines aren't going to sing no matter how much you tune them. Putting money into a hardware upgrade for these old dogs should be carefully weighed: new parts can be difficult to locate and everything in the box is suspect.

It's not so bad for a Phenom II or Core 2 box. In fact, these machines can be quite workable if the user has realistic expectations. Dropping an SSD into a Phenom II or Core 2 rig would be a game-changer for these old platforms, even if the motherboard doesn't support the full SATA 6Gb/s speeds. Sometimes, a little RAM will even help, if the box was already memory-starved to begin with. With a 64-bit OS, 8GB is standard and 4GB is borderline.

If gaming needs a boost, dropping in a newer GPU can certainly help. Even those rigs that are constrained by low-wattage PSUs now have a modern option with Nvidia's new Maxwell series, which can run on even 300W PSUs (for more on Maxwell, see page 40).

intel®
pentium® 4

**Unless you're in the retro computing club, we'd recommend dumping that Pentium 4 box.**

If the machine is also running that now-abandoned OS, Windows XP, an OS upgrade to Windows 7 or even Windows 8 is advised.

Obviously, we don't recommend $400 in upgrades on a $200 PC, but a $100 upgrade on a box that buys the person another 24 months of use can be a godsend for those on tight budgets. As we said, though, everything below the P4/Athlon XP line should be abandoned.

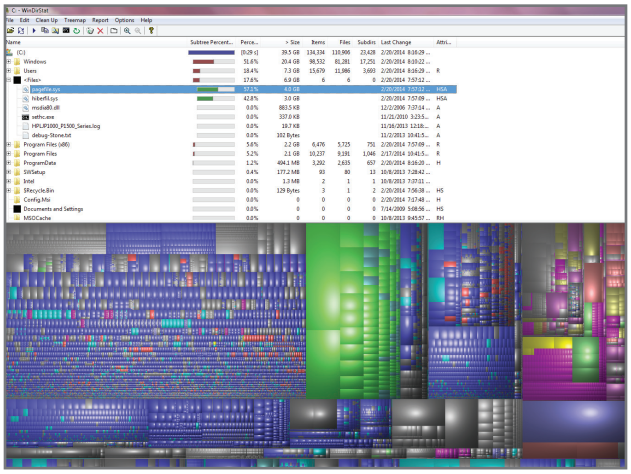
# VISUALIZE YOUR DRIVE

## Think of WinDirStat as Google Maps for your HDDs

You've cleaned up the extraneous system files on your machine, but the real junk is the gigabytes of nothingness you've collected from repeatedly dumping that 32GB memory card onto the hard drive because you were afraid to delete something you might need later. Six months later, those same unkempt files are bogging down your system and freeloading on your dime. When space gets tight, we turn to WinDirStat (www.windirstat.info).

In the past, when drives were smaller and your file-hoarding was limited to a mere 500GB or so, you could rely on the good old-fashioned search-and-destroy technique: browsing through Windows Explorer for old photos, games, and files that you simply don't use anymore. With 3TB and even 4TB drives packed with god knows what, that technique isn't effective anymore. Instead, use Windows Directory Statistics, or WinDirStat, to help visualize and locate files on our drives that can be slated for termination. WinDirStat is an extremely lightweight (less than a megabyte) open-source program that scans your hard drive to provide you with three sets of information: directory list, tree map, and file extensions list. The tree map—easily the most attractive feature in the program—represents every file on your hard drive as a colored rectangle. Also handy is the extension list, which gives you total percentages calculated by file extensions.

The tree map is the handiest and helps you easily see where you have bloat on your drives—the bigger the file, the bigger the rectangle. Scrolling over files displays the file name and its location, and you can delete files from within the program by selecting a file and pressing the delete key.



| Name | Subtree Percent... | Perce... | > Size | Items | Files | Subdirs | Last Change | Attri... |
|---|---|---|---|---|---|---|---|---|
| (C:) | | [0:29 s] | 39.5 GB | 134,334 | 110,906 | 23,428 | 2/20/2014 8:16:29 ... | |
| Windows | | 51.6% | 20.4 GB | 98,532 | 81,281 | 17,251 | 2/20/2014 8:10:22 ... | |
| Users | | 18.4% | 7.3 GB | 15,679 | 11,986 | 3,693 | 2/20/2014 8:16:29 ... | R |
| <Files> | | 17.6% | 6.9 GB | 6 | 6 | 0 | 2/20/2014 7:57:12 ... | |
| pagefile.sys | | 57.1% | 4.0 GB | | | | 2/20/2014 7:57:12 ... | HSA |
| hiberfil.sys | | 42.8% | 3.0 GB | | | | 2/20/2014 7:57:09 ... | HSA |
| msdia80.dll | | 0.0% | 883.5 KB | | | | 12/2/2006 7:37:14 ... | A |
| sethc.exe | | 0.0% | 337.0 KB | | | | 11/21/2010 3:23:5... | A |
| HPLJP1000_P1500_Series.log | | 0.0% | 19.7 KB | | | | 11/16/2013 12:18:... | A |
| debug-Stone.txt | | 0.0% | 102 Bytes | | | | 11/2/2013 10:41:5... | A |
| Program Files (x86) | | 5.6% | 2.2 GB | 6,476 | 5,725 | 751 | 2/20/2014 7:57:09 ... | R |
| Program Files | | 5.2% | 2.1 GB | 10,237 | 9,191 | 1,046 | 2/17/2014 10:41:5... | R |
| ProgramData | | 1.2% | 494.1 MB | 3,292 | 2,635 | 657 | 2/20/2014 8:16:20 ... | H |
| SWSetup | | 0.4% | 177.2 MB | 93 | 80 | 13 | 10/8/2013 7:28:42 ... | |
| Intel | | 0.0% | 1.3 MB | 2 | 1 | 1 | 10/8/2013 7:37:11 ... | |
| $Recycle.Bin | | 0.0% | 129 Bytes | 3 | 1 | 2 | 2/20/2014 7:56:38 ... | HS |
| Config.Msi | | 0.0% | 0 | 0 | 0 | 0 | 2/20/2014 7:17:48 ... | H |
| Documents and Settings | | 0.0% | 0 | 0 | 0 | 0 | 7/14/2009 5:08:56 ... | HS |
| MSOCache | | 0.0% | 0 | 0 | 0 | 0 | 10/8/2013 9:45:57 ... | RH |

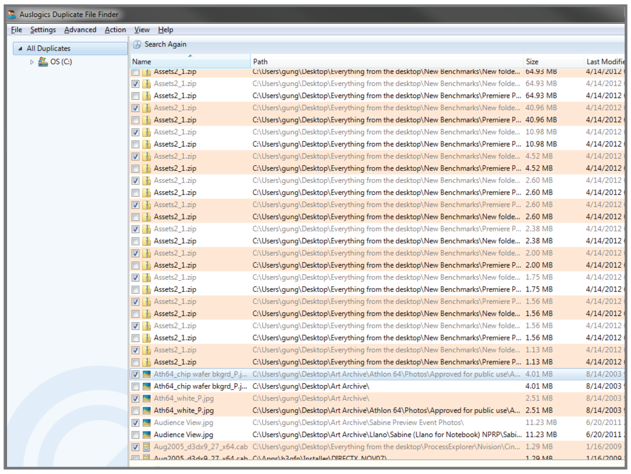
**We dig the simple and effective representation of our hard drives from WinDirStat.**

# DEDUPE IT

## Duplicate often

Most people treat hard drives like the attic or garage. Rather than immediately culling extra files, you simply put it in storage to deal with at a later date (the road to hell, good intentions, etc). No matter that you already put those files in storage just last week—you'll get around to dumping the duplicate files eventually. While there are many, many deduplication tools available, one good starting place is Auslogic's free Duplicate File Finder app (www.auslogics.com) It doesn't have the bells or whistles of apps that analyze audio, photo, and video for duplicates, but it works fairly fast and is a good way to eliminate the obvious duplicate files. On one old Windows 7 box, Duplicate File Finder turned up a good 39GB of dupes that could be tossed. Simply fire up Duplicate File Finder, have it search your drive, and it will give you a list of duplicate files. Under Action, select All Duplicates In Each Group, and it will mark the duplicate files for dumping into a trash can, or moving into the Rescue Center, where you can recover the file if you realize later on you made a mistake.

The program works well enough, but we wouldn't wipe out files willy-nilly without first making a separate backup and making sure that the irreplaceable files going away are actually duplicates. DFF will show you the file name, file size, and creation date, which gives most people enough confidence to delete, but the paranoia in us would want to visually confirm it, too. This same philosophy is probably what brought us to this space issue in the first place. After all, am I sure I really did copy *all* of the images from the memory card to the computer? Even the ones I took last weekend? I'll just make another copy… I have plenty of space.


Auslogics Duplicate File Finder
File Settings Advanced Action View Help
All Duplicates
OS (C:)
Search Again

| | Name | Path | Size | Last Modifie |
|---|---|---|---|---|
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 64.93 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 64.93 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 64.93 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 40.96 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 40.96 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 10.98 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 10.98 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 4.52 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 4.52 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 2.60 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 2.60 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 2.60 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 2.60 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 2.38 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 2.38 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 2.00 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 2.00 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 1.75 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 1.75 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 1.56 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 1.56 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 1.56 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 1.56 MB | 4/14/2012 |
| ☑ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\New folde... | 1.13 MB | 4/14/2012 |
| ☐ | Assets2_1.zip | C:\Users\gung\Desktop\Everything from the desktop\New Benchmarks\Premiere P... | 1.13 MB | 4/14/2012 |
| ☑ | Ath64_chip wafer bkgrd_P.j... | C:\Users\gung\Desktop\Art Archive\Athlon 64\Photos\Approved for public use\A... | 4.01 MB | 8/14/2003 |
| ☐ | Ath64_chip wafer bkgrd_P.j... | C:\Users\gung\Desktop\Art Archive\ | 4.01 MB | 8/14/2003 |
| ☑ | Ath64_white_P.jpg | C:\Users\gung\Desktop\Art Archive\ | 2.51 MB | 8/14/2003 |
| ☐ | Ath64_white_P.jpg | C:\Users\gung\Desktop\Art Archive\Athlon 64\Photos\Approved for public use\A... | 2.51 MB | 8/14/2003 |
| ☑ | Audience View.jpg | C:\Users\gung\Desktop\Art Archive\Sabine Preview Event Photos\ | 11.23 MB | 6/20/2011 |
| ☐ | Audience View.jpg | C:\Users\gung\Desktop\Art Archive\Llano\Sabine (Llano for Notebook) NPRP\Sabi... | 11.23 MB | 6/20/2011 |
| ☑ | Aug2005_d3dx9_27_x64.cab | C:\Users\gung\Desktop\Everything from the desktop\ProcessExplorer\Nvision\Cin... | 1.29 MB | 1/16/2009 |
| ☐ | Aug2005_d3dx9_27_x64.cab | C:\Apps\b3gfp\Installer\DIRECTX_NOV07\ | 1.29 MB | 1/16/2009 |

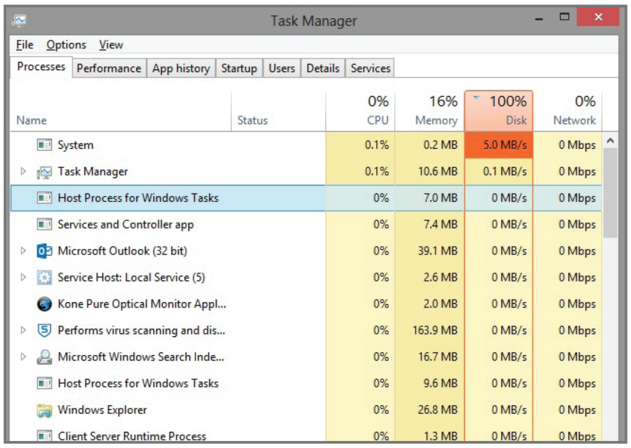
**Duplicate File Finder can quickly, er, find your duplicate files.**

# OPTIMIZE YOUR STORAGE

## Storage is usually the prime suspect in system slowdowns

Before we get started discussing problems with your storage system and how to optimize it, make sure you have done two things: First, that you've connected your SSD to a SATA 6Gb/s port on your motherboard (consult your manual), and second, that you've enabled AHCI on your SATA controller via the motherboard BIOS. If you've already installed Windows and your SATA controller is set to IDE instead of AHCI, hit Google to find the registry hack to fix it. And yes, running in IDE mode rather than AHCI on a modern SSD can indeed rob you of performance.

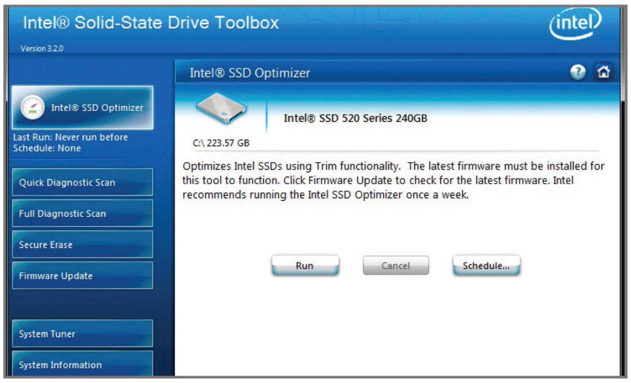
With that out of the way, the first thing to do when you sense your system is slowing down and you see your hard-drive activity LED churning constantly, is enlist the trusty three-finger salute. For the uninitiated, that means pressing ctrl-alt-delete to bring up the Task Manager in Windows. Select the Performance tab to see if anything is spiking or is nearing 100 percent utilization. From there, you can go to the Processes tab to see which process is taking up all those resources. In the screenshot below, we see a staff member's work PC that suffered daily paralyzation at the hands of a virus scan and several associated processes. The resolution was to kill the processes, then make sure to schedule the virus scans during non-work hours.



| Name | Status | 0%<br>CPU | 16%<br>Memory | 100%<br>Disk | 0%<br>Network |
|---|---|---|---|---|---|
| System | | 0.1% | 0.2 MB | 5.0 MB/s | 0 Mbps |
| Task Manager | | 0.1% | 10.6 MB | 0.1 MB/s | 0 Mbps |
| Host Process for Windows Tasks | | 0% | 7.0 MB | 0 MB/s | 0 Mbps |
| Services and Controller app | | 0% | 7.4 MB | 0 MB/s | 0 Mbps |
| Microsoft Outlook (32 bit) | | 0% | 39.1 MB | 0 MB/s | 0 Mbps |
| Service Host: Local Service (5) | | 0% | 2.6 MB | 0 MB/s | 0 Mbps |
| Kone Pure Optical Monitor Appl... | | 0% | 2.0 MB | 0 MB/s | 0 Mbps |
| Performs virus scanning and dis... | | 0% | 163.9 MB | 0 MB/s | 0 Mbps |
| Microsoft Windows Search Inde... | | 0% | 16.7 MB | 0 MB/s | 0 Mbps |
| Host Process for Windows Tasks | | 0% | 9.6 MB | 0 MB/s | 0 Mbps |
| Windows Explorer | | 0% | 26.8 MB | 0 MB/s | 0 Mbps |
| Client Server Runtime Process | | 0% | 1.3 MB | 0 MB/s | 0 Mbps |

**If your system feels like it's stuck in the mud, the Task Manager will reveal what's causing the problem.**

If everything looks fine in the Task Manager but the system still feels slow, run a few benchmarks to see if the numbers are up to spec. For sequential read and write tests, we recommend CrystalDiskMark for SSDs and HDTune for Hard drives. Admittedly, none of us use HDDs for our OS anymore—there's no reason to with SSD prices falling faster than the value of Bitcoin.



Last Run: Never run before
Schedule: None

Intel® SSD 520 Series 240GB

C:\ 223.57 GB

Optimizes Intel SSDs using Trim functionality. The latest firmware must be installed for this tool to function. Click Firmware Update to check for the latest firmware. Intel recommends running the Intel SSD Optimizer once a week.

**Both Samsung and Intel offer free "tuning" software that helps keep your SSD running in tip-top shape.**

If you run the benchmarks and find the performance is lacking on your SSD, you have a few options. Your first is to optimize the drive via the Trim command. What this does is send a command to the drive that tells it to run its garbage-collection routine, which means it will erase all the blocks that have been deleted, clearing the way for them to receive fresh writes. If the drive has not been trimmed in a while, data can become fragmented all over the drive, and since blocks of an SSD have to be erased before they are written to (as opposed to a hard drive, where they can just be overwritten at any time), a simple write command can require the controller to delete blocks, move data around, and then perform the write, which can seriously degrade performance.

In general, if you're running Windows 7 or newer, you should be fine. However, you can Trim a drive manually on Windows 8: right-click the drive in My Computer, and click Properties, Tools, and then Optimize. If you own a Samsung or Intel SSD, you can download the free Samsung Magician or SSD Toolbox software, respectively, which also let you Trim your drive.

# HDD "OPTIMIZATION"

## Fast hard drives aren't

If you are running a hard drive and want to optimize it, there's not a whole lot you can do beyond keeping it defragmented. To make sure it's "defragged," right-click the drive, select Properties, Tools, and then Defragmentation. Ideally, you should do this after you've done your spring cleaning of unused junk from the machine. If it's your boot device, some people like to disable hibernation before a defrag to get a little extra "boost" out of the defrag by eliminating the multi-gigabyte hiberfil.sys file. Frankly, we don't think it matters much anymore. In our opinion, the concept of a "fast hard drive" is antiquated now, due to SSDs, as is the concept of "optimizing" them. Any gains you make toward keeping a hard drive optimized will be largely unnoticeable in the real world, beyond dumping the useless cruft and running a basic defrag, which the OS will do on its own.

# LET'S GET PHYSICAL

## Knock, knock, house cleaning

Unless you live in a HEPA-filtered cleanroom, a desktop PC will eventually need a physical cleanup as well as a digital one. That means opening up the case, which means turning off your rig and unplugging it from the wall. Don't want to lose a finger in those fan blades. Most case panels are secured with six-sided Phillips screws, sometimes call a "hex" screw. Or they have thumbscrews, which can usually be removed by hand. Once taken out, keep these together in a small container. An empty coffee mug will do in a pinch.

If you've had this PC for several months, you should see a coating of dust inside. That has to be removed, because it insulates surfaces and clogs up fans, which can lead to overheating. With a can of compressed air, spray short bursts at the dust. Long sprays can freeze the inner workings of the can. And tilting the can may also cause its liquid to spray, which contains a solvent that can damage the contact surface. Ideally, do this dusting outside, because you don't want all that dust floating around indoors.

Case fan filters can also get gnarly. These days, most of them slide out. Spray them with air, or remove them, run them under the tap, and air dry. Fans themselves also get grody. You may need to temporarily remove the CPU fan from the heatsink to clean both items sufficiently. When spraying fans, hold their blades down to prevent them from spinning, otherwise you may damage the motor.

A periodic disinfecting wipe or baby wipe can take care of your mouse, but keyboards usually need you to pull their keycaps to really get at the crustiness underneath. A puller tool is best for this. You can order one online from Newegg or Amazon, and regional computer stores like Fry's and Microcenter usually sell them. Some people run their boards through the dishwasher. Don't use detergent or hot water for that, and give them at least a day to fully dry out.

Last but not least, don't forget to wipe the dust off your monitor's screen. But don't use conventional glass cleaner, because it can permanently damage the panel. You can buy screen-cleaning kits from most office supply stores, or you can use a spare microfiber cloth, like the kind made for camera lenses. Pharmacies also stock these. Just gently wipe the screen with it. If you need some liquid to clean the screen, spray your cloth with plain water from a mister. Never spray the screen itself, because the liquid can drip into the panel housing and corrode the components within.

**Tuxie the cat, pointing out a spot Josh missed while cleaning.**

WIPES LINGETTES TOALLITAS
HUGGIES
Natural Care
Thick 'n' Clean

**Gordon agrees, baby wipes work amazingly well for cleaning the surfaces of a dirty desktop or laptop.**

> "SMOKERS AND OWNERS OF FURRY PETS WILL ALSO NEED TO CLEAN MORE OFTEN THAN USUAL

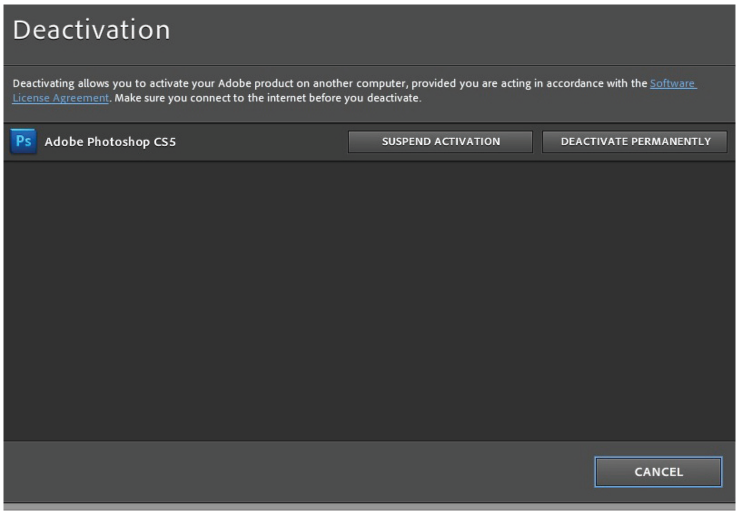
### AN OUNCE OF PREVENTION

If you've just cleaned out a rig that's never seen a proper cleaning, you're probably wondering what you can do to avoid such horrors in the future. Fan filters are obviously one option. If they're not built into your case, you can get them from sites like Newegg, Amazon, and Frozen CPU. Some have magnets, and you just slap them on; others need to be screwed in. To get the correct sizing, measure your fan diagonally with a ruler. The most common size is 120mm. A filter's dense mesh will reduce airflow and increase temps in the case, so there's a trade-off. Even the best filter will not completely eliminate dust, it will only reduce the number of times per year that you need to clean the insides. Smokers and owners of furry pets will also need to clean more often than usual. Periodically brushing those critters will help reduce buildup.

And we don't know if we have to mention this, but washing your hands a few times over the course of the day will also help prevent unsightly crud from building up on your input devices. This is especially important after a meal or after spending time outdoors. And speaking of food, try to keep it away from your keyboard, which is a crumb magnet and said to be dirtier than a toilet. If your mouse pad has an old-style fabric surface, you may want to consider eliminating it altogether (unless your desk is made of glass), or switching to one made of plastic or metal—materials that can be cleaned quickly and easily.

# NUKE IT FROM ORBIT

## Nothing can save LV426, so when it's too mangled or infested, just nuke it



Deactivation

Deactivating allows you to activate your Adobe product on another computer, provided you are acting in accordance with the Software License Agreement. Make sure you connect to the internet before you deactivate.

Ps
Adobe Photoshop CS5
SUSPEND ACTIVATION
DEACTIVATE PERMANENTLY
CANCEL

**In order to reinstall certain software, such as Adobe products, you must first deactivate the serial key.**

We won't bother telling you to back up your data before you send your OS to meet its maker, because that is too obvious. But before you nuke the OS, make sure you have everything you need.

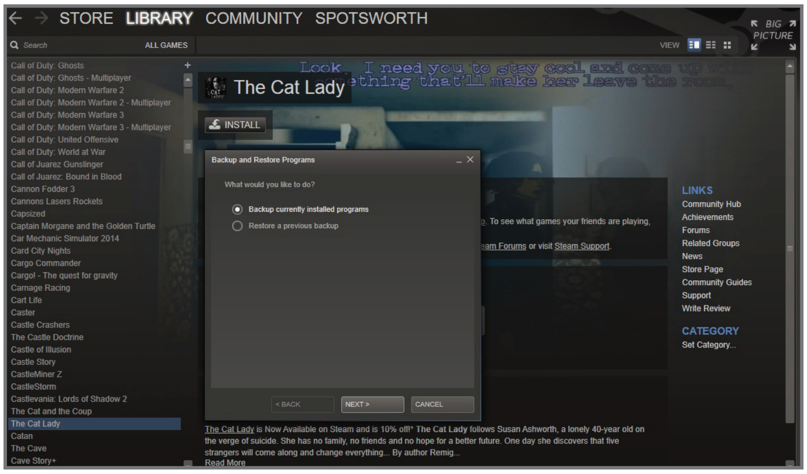
What might not be obvious is that because of piracy, a lot of the more expensive software packages require activation, which also requires you to deactivate any serial numbers before you begin your bombing run. Most professional Adobe packages work this way, so if you're running Photoshop, Illustrator, or any locally stored creative suite, be sure to open the app, click Help, and then Deactivate. Make sure you've done it correctly by firing up the program again to see if it asks you to activate. If it does, you're good to go; keep in mind you'll need Internet access to successfully do this. Also keep in mind that if you deactivate a piece of software, then upgrade your system, the software might think it's a different computer, which can complicate re-activation.

The activation process varies on a program-to-program basis, so use Google if you run into any issues. Microsoft's Office suites react the same as the operating system, and any significant change in hardware will trigger a reactivation. The bottom line: If you have a mission critical application that you absolutely have to have up and running as soon as possible, be sure to know what the re-activation process is before you pull the trigger so there are no surprises. Some apps require you to contact the vendor for a new code before they will run, which is a wonderful thing to learn at midnight Friday before a three-day weekend when you need the app that night.

There are other apps you should also pay attention to. First up, browser bookmarks. Chrome will let you sync your bookmarks on other machines, but you need to set it up to do so. If you're into the old-school method, you can also export your bookmarks file as HTML and then re-import it. You'll want to make sure you have a copy of your iTunes library handy, too, which is located in C:\Users\Username\My Music. Be sure to deauthorize iTunes while you're at it. You'll also want to back up your Steam library so that you don't have to re-download all your games. To do this in Steam, click Steam in the upper left-hand corner, select Backup and Restore Games, then follow the prompts. Alternatively, you can do it manually by copying the entire Steam directory over. You no longer have to worry about save-game files, since they are now all automatically saved to the "Steam Cloud."

Your final stop on this trail of tears is to make sure you have all the drivers you need for anything connected to your PC. At the very minimum, be sure to have your chipset and LAN drivers, as those always go first, and with an Internet connection you can always download anything else you need care of the helpful SlimDrivers utility. Don't forget your printer drivers, though, and it doesn't hurt to download Windows 7 SP1 or Windows 8.1 either, though Windows Update could also do it for you.

Once you've deactivated your software, collected all the serial keys you need, made sure your Steam and iTunes libraries are backed up, saved your browser bookmarks, and have all your drivers, you are ready to proceed. Before you reboot your PC to reinstall, be sure to take a moment to consider all the amazing times it's given you. Once that's complete, shut her down, and we'll see you on the other side. ⏻



Backup and Restore Programs

What would you like to do?

● Backup currently installed programs

○ Restore a previous backup

. To see what games your friends are playing,

eam Forums or visit Steam Support.

The Cat Lady is Now Available on Steam and is 10% off!* The Cat Lady follows Susan Ashworth, a lonely 40-year old on the verge of suicide. She has no family, no friends and no hope for a better future. One day she discovers that five strangers will come along and change everything... By author Remig...

STORE
LIBRARY
COMMUNITY
SPOTSWORTH
BIG PICTURE
Search
ALL GAMES
VIEW
Call of Duty: Ghosts
Call of Duty: Ghosts - Multiplayer
Call of Duty: Modern Warfare 2
Call of Duty: Modern Warfare 2 - Multiplayer
Call of Duty: Modern Warfare 3
Call of Duty: Modern Warfare 3 - Multiplayer
Call of Duty: United Offensive
Call of Duty: World at War
Call of Juarez Gunslinger
Call of Juarez: Bound in Blood
Cannon Fodder 3
Cannons Lasers Rockets
Capsized
Captain Morgane and the Golden Turtle
Car Mechanic Simulator 2014
Card City Nights
Cargo Commander
Cargo! - The quest for gravity
Carnage Racing
Cart Life
Caster
Castle Crashers
The Castle Doctrine
Castle of Illusion
Castle Story
CastleMiner Z
CastleStorm
Castlevania: Lords of Shadow 2
The Cat and the Coup
The Cat Lady
Catan
The Cave
Cave Story+
Look. I need you to stay cool and come up with something that'll make her leave the room.
The Cat Lady
INSTALL
< BACK
NEXT >
CANCEL
LINKS
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**Steam includes a built-in Backup and Restore tool, and we recommend using it.**

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GIGABYTE
WINDFORCE
GIGABYTE

# SHOW AT THE 1080P COR

# DOWN

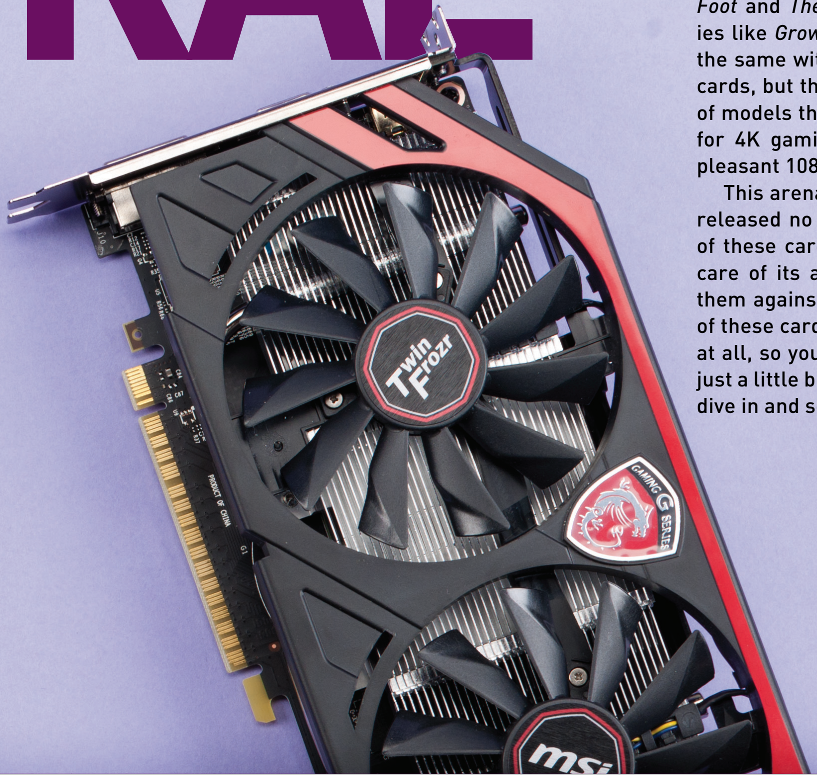
# RAL

## SIX ENTRY-LEVEL CARDS BATTLE FOR BUDGET-BOARD BRAGGING RIGHTS

**BY JOSH NOREM**

The video-card game is a lot like Hollywood. Movies like *My Left Foot* and *The Artist* take home the Oscars every year, but movies like *Grown Ups 2* and *Transformers 3* pull in all the cash. It's the same with GPUs, in that everyone loves to talk about $1,000 cards, but the actual bread-and-butter of the market is made up of models that cost between $100 and $150. These are not GPUs for 4K gaming, obviously, but they can provide a surprisingly pleasant 1080p gaming experience, and run cool and quiet, too.

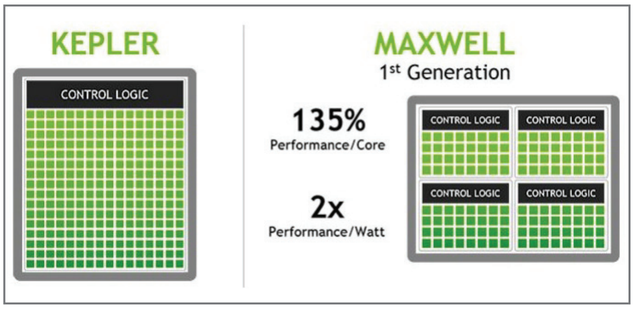
This arena has been so hot that AMD and Nvidia have recently released no fewer than six cards aimed at budget buyers. Four of these cards are from AMD, and Nvidia launched two models care of its all-new Maxwell architecture, so we decided to pit them against one another in an old-fashioned GPU roundup. All of these cards use either a single six-pin PCIe connector or none at all, so you don't even need a burly power supply to run them, just a little bit of scratch and the desire to get your game on. Let's dive in and see who rules the roost!



# NVIDIA'S MAXWELL CHANGES THE GAME

Budget GPUs have always been low-power components, and usually need just a single six-pin PCIe power connector to run them. After all, a budget GPU goes into a budget build, and those PCs typically don't come with the 600W-or-higher power supplies that provide dual six- or eight-pin PCIe connectors. Since many budget PSUs done have PCIe connectors, most of these cards come with Molex adapters in case you don't have one. The typical thermal design power (TDP) of these cards is around 110 watts or so, but that number fluctuates up and down according to spec. For comparison, the Radeon R9 290X has a TDP of roughly 300 watts, and Nvidia's flagship card, the GTX 780 Ti, has a TDP of 250W, so these budget cards don't have a lot of juice to work with. Therefore, efficiency is key, as the GPUs need to make the most out of the teeny, tiny bit of wattage they are allotted. During 2013, we saw AMD and Nvidia release GPUs based on all-new 28nm architectures named GCN and Kepler, respectively, and though Nvidia held a decisive advantage in the efficiency battle, it's taken things to the next level with its new ultra-low-power Maxwell GPUs that were released in February 2014.

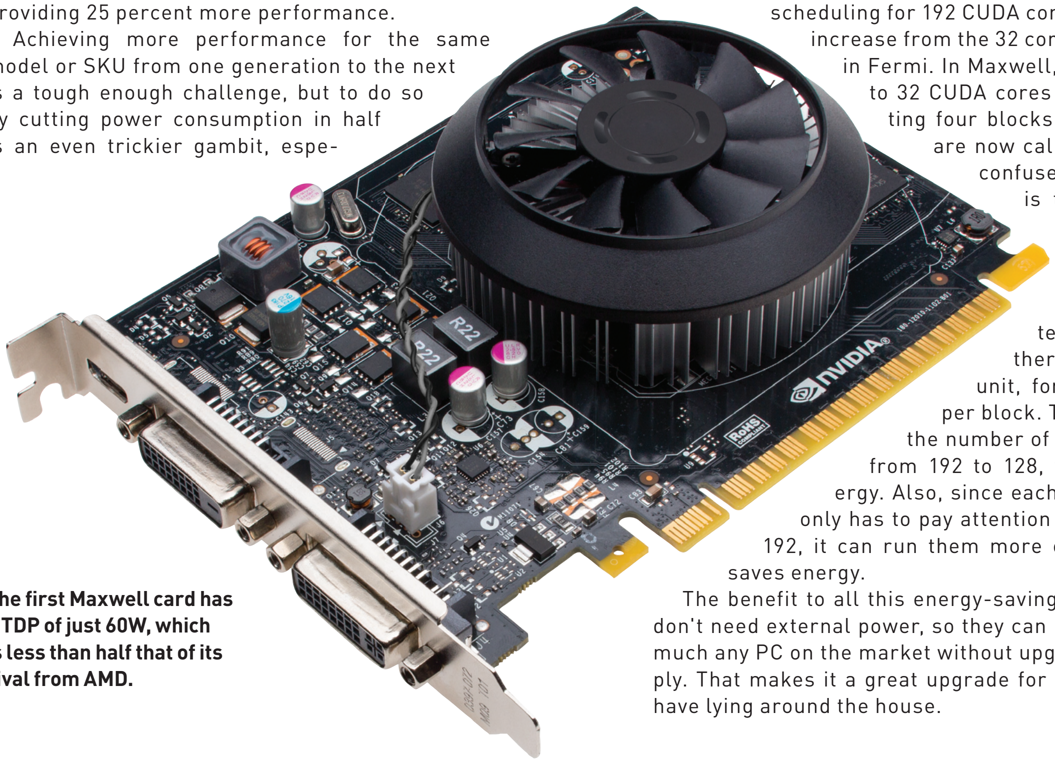
Beginning with the GTX 750 Ti and the GTX 750, Nvidia is embarking on a whole new course for its GPUs, centered around maximum power efficiency. The goal with its former Kepler architecture was to have better performance per watt compared to the previous architecture named Fermi, and it succeeded, but it's taken that same philosophy even further with Maxwell, which had as its goal to be twice as efficient as Kepler while providing 25 percent more performance.



**Maxwell offers far greater power savings by using more granular clock gating, which allows it to shut down unused graphics units.**

Achieving more performance for the same model or SKU from one generation to the next is a tough enough challenge, but to do so by cutting power consumption in half is an even trickier gambit, especially considering the Maxwell GPUs are being fabricated on the same 28nm process it used for Kepler. We always expect more performance for less power when moving from one process to the next, such as 32nm to 28nm or 22nm to 14nm, but to do so on the same process is an amazing achievement indeed. Though Nvidia used many technological advances to reduce power consumption, the main structural change was to how the individual CUDA cores inside the Graphics Processing Clusters (GPCs) are organized and controlled. In Kepler, each GPC contained individual processing units, named SMX units, and each unit featured a piece of control logic that handled scheduling for 192 CUDA cores, which was a major increase from the 32 cores in each block found in Fermi. In Maxwell, Nvidia has gone back to 32 CUDA cores per block, but is putting four blocks into each unit, which are now called SM units. If you're confused, the simple version is this—rather than one piece of logic controlling 192 cores, Maxwell has a piece of logic for each cluster of 32 cores, and there are four clusters per unit, for a total of 128 cores per block. Therefore, it's reduced the number of cores per block by 64, from 192 to 128, which helps save energy. Also, since each piece of control logic only has to pay attention to 32 cores instead of 192, it can run them more efficiently, which also saves energy.

The benefit to all this energy-saving is the GTX 750 cards don't need external power, so they can be dropped into pretty much any PC on the market without upgrading the power supply. That makes it a great upgrade for any pre-built POS you have lying around the house.



**The first Maxwell card has a TDP of just 60W, which is less than half that of its rival from AMD.**

# GIGABYTE GTX 750 TI WINDFORCE

The WindForce cooler is overkill, but we like it that way.

**NVIDIA'S NEW** Maxwell cards run surprisingly cool and quiet in stock trim, and that's with a fan no larger than an oversized Ritz cracker, so you can guess what happens when you throw a mid-sized WindForce cooler onto one of them. Yep, it's so quiet and cool you have to check with your fingers to see if it's even running. This bad boy ran at 45 C under load, making it the coolest-running card we've ever tested, so kudos to Nvidia and Gigabyte on holding it down (the temps, that is). This board comes off the factory line with a very mild overclock of just 13MHz (why even bother, seriously), and its boost clock has been massaged up to 1,111MHz from 1,085MHz, but as always, this is just a starting point for your overclocking adventures. The memory is kept at reference speeds however, running at 5,400MHz. The board sports 2GB of GDDR5 memory, and uses a custom design for its blue-colored PCB. It features two 80mm fans and an 8mm copper heat pipe. Most interesting is the board requires a six-pin PCIe connector, unlike the reference design, which does not.

In testing, the GTX 750 Ti WindForce was neck-and-neck with the Nvidia reference design, proving that Nvidia did a pretty good job with this card, and that its cooling requirements don't really warrant such an outlandish cooler. Still, we'll take it, and we loved that it was totally silent at all times. Overclocking potential is higher, of course, but since the reference design overclocked to 1,270MHz or so, we don't think you should expect moon-shot overclocking records. Still, this card was rock solid, whisper quiet, and extremely cool.

**VERDICT** 9

**Gigabyte GTX 750 Ti WindForce**

$160 (street), www.gigabyte.us

# MSI GEFORCE GTX 750 GAMING

MSI's Twin Frozr cooling apparatus transforms this svelte GPU into a full-sized card.

**MUCH LIKE** Gigabyte's GTX 750 Ti WindForce card, the MSI GTX 750 Gaming is a low-power board with a massive Twin Frozr cooler attached to it for truly exceptional cooling performance. The only downside is the formerly waifish GPU has been transformed into a full-size card, measuring more than nine inches long. Unlike the Gigabyte card though, this GPU eschews the six-pin PCIe connector, as it's just a 55W board, and since the PCIe slot delivers up to 75W, it doesn't even need the juice. Despite this card's entry-level billing, MSI has fitted it with "military-class" components for better overclocking and improved stability. It uses twin heat pipes to dual 100mm fans to keep it cool, as well. It also includes a switch that lets you toggle between booting from an older BIOS in case you run into overclocking issues.

Speaking of which, this board lives up to its name and has a beefy overclock right out of the box, running at 1,085MHz base clock and 1,163MHz boost clock. It features 1GB of GDDR5 RAM on a 128-bit interface.

The Twin Frozr cooler handles the miniscule amount of heat coming out of this board with aplomb—we were able to press our finger forcibly on the heatsink under load and felt almost no warmth, sort of like when we give Gordon a hug when he arrives at the office. As the only GTX 750 in this test, it showed it could run our entire test suite at decent frame rates, but it traded barbs with the slightly less expensive Radeon R7 260X. On paper, both the GTX 750 and the R7 260X are about $119, but rising prices from either increased demand or low supply have placed both cards in the $150 range, making it a dead heat. Still, it's a very good option for those who want an Nvidia GPU and its ecosystem but can't afford the Ti model.

**VERDICT** 8

**MSI GeForce GTX 750 Gaming**

$140, www.msi.com

# SAPPHIRE RADEON R7 265 DUAL-X

Sapphire's R7 265 is the third card in this roundup to use a two-fan cooling apparatus.

**THE SAPPHIRE RADEON** R7 265 is the odds-on favorite in this roundup, due to its impressive specs and the fact that it consumes more than twice the power of the Nvidia cards. Sure, it's an unfair advantage, but hate the game, not the player. This board is essentially a rebadged Radeon HD 7850, which is a Pitcairn part, and it slides right in between the $120 R7 260X and the $180ish R7 270. This card actually has the same clock speeds as the R7 270, but features fewer streaming processors for reduced shader performance. It has the same 2GB of memory, same 925MHz boost clock, same 256-bit memory bus, and so on. At 150W, its TDP is very high—or at least it seems high, given that the GTX 750 Ti costs the exact same $150 and is sitting at just 60W. Unlike the lower-priced R7 260X Bonaire part, though, the R7 265 is older silicon and thus does not support TrueAudio and XDMA CrossFire (bridgeless CrossFire, basically). However, it will support the Mantle API, someday.

The Sapphire card delivered the goods in testing, boasting top scores in many benchmarks and coming in as the only GPU in this roundup to hit the magical 60fps in any test, which was a blistering turn in Call of Duty: Ghosts where it hit 67fps at 1080p on Ultra settings. That's damned impressive, as was its ability to run at 49fps in Battlefield 4, though the GTX 750 Ti was just a few frames behind it. Overall, though, this card cleaned up, taking first place in seven out of nine benchmarks. If that isn't a Kick Ass performance, we don't know what is. The Dual-X cooler also kept temps and noise in check, too, making this the go-to GPU for those with small boxes or small monitors.

**VERDICT 9 KICK ASS!**

**Sapphire Radeon R7 265 Dual-X**

$150 (MSRP), www.sapphiretech.com

# AMD RADEON R7 260X

This $120 card supports Mantle, TrueAudio, and CrossFire.

**THE RADEON R7 260X** was originally AMD's go-to card for 1080p gaming on a budget. It's the only card in the company's sub-$200 lineup that supports all the next-gen features that appeared in its Hawaii-based flagship boards, including support for TrueAudio, XDMA Crossfire, Mantle (as in, it worked at launch), and it has the ability to drive up to three displays —all from this tiny $120 GPU. Not bad. In its previous life, this GPU was known as the Radeon HD 7790, aka Bonaire, and it was our favorite "budget" GPU when pitted against the Nvidia GTX 650 Ti Boost due to its decent performance and amazing at-the-time game bundles. It features a 128-bit memory bus, 896 Stream Processors, 2GB of RAM (up from 1GB on the previous card), and a healthy boost clock of 1,100MHz. TDP is just 115W, so it slots right in between the Nvidia cards and the higher-end R7 265 board. Essentially, this is an HD 7790 card with 1GB more RAM, and support for TrueAudio, which we have yet to experience.

In testing, the R7 260X delivered passable performance, staking out the middle ground between the faster R7 265 and the much slower R7 250 cards. It ran at about 30fps in tests like Crysis 3 and Tomb Raider, but hit 51fps on CoD: Ghosts and 40fps on Battlefield 4, so it's certainly got enough horsepower to run the latest games on max settings. The fact that it supports all the latest technology from AMD is what bolsters this card's credentials, though. And the fact that it can run Mantle with no problems (see page 51 for benchmarks) is a big plus for Battlefield 4 players. We like this card a lot, just like we enjoyed the HD 7790. While it's not the fastest card in the bunch, it's certainly far from the slowest.

**VERDICT 8**

**AMD Radeon R7 260X**

$120, www.amd.com

# SHOULD YOU TAKE THE RED PILL OR THE GREEN PILL?

Both companies offer proprietary technologies to lure you into their "ecosystems," so let's take a look at what each has to offer

## NVIDIA'S OFFERINGS

### G-SYNC

Nvidia's G-Sync technology is arguably one of the strongest cards in Nvidia's hand, as it eliminates tearing in video games caused by the display's refresh rate being out of sync with the frame rate of the GPU. The silicon syncs the refresh rate with the cycle of frames rendered by the GPU, so movement onscreen looks buttery smooth at all times, even below 30fps. The only downside is you must have a G-Sync monitor, so that limits your selection quite a bit.

### REGULAR DRIVER RELEASES

People love to say Nvidia has "better drivers" than AMD, and though the notion of "better" is debatable, it certainly releases them much more frequently than AMD. That's not to say AMD is a slouch—especially now that it releases a new "beta" build each month—but Nvidia seems to be paying more attention to driver support than AMD.

### GEFORCE EXPERIENCE AND SHADOWPLAY

Nvidia's GeForce Experience software will automatically optimize any supported games you have installed, and also lets you stream to Twitch as well as capture in-game footage via ShadowPlay. It's a really slick piece of software, and though we don't need a software program to tell us "hey, max out all settings," we do love ShadowPlay.

### PHYSX

Nvidia's proprietary PhysX software allows game developers to include billowing smoke, exploding particles, cloth simulation, flowing liquids, and more, but there's just one problem—very few games utilize it. Even worse, the ones that do utilize it, do so in a way that is simply not that impressive, with one exception: Borderlands 2.

## AMD'S OFFERINGS

### MANTLE AND TRUEAUDIO

AMD is hoping that Mantle and TrueAudio become the must-have "killer technology" it offers over Nvidia, but at this early stage, it's difficult to say with certainty if that will ever happen. Mantle is a lower-level API that allows developers to optimize a game specifically targeted at AMD hardware, allowing for improved performance.

### TRESSFX

This is proprietary physics technology similar to Nvidia's PhysX in that it only appears in certain games, and does very specific things. Thus far, we've only seen it used once—for Lara Croft's hair in Tomb Raider. Instead of a blocky ponytail, her mane is flowing and gets blown around by the wind. It looks cool but is by no means a must-have item on your shopping list, just like Nvidia's PhysX.

### GAMING EVOLVED BY RAPTR

This software package is for Radeon users only, and does several things. First, it will automatically optimize supported games you have installed, and it also connects you to a huge community of gamers across all platforms, including PC and console. You can see who is playing what, track achievements, chat with friends, and also broadcast to Twitch.tv, too. AMD also has a "rewards" program that doles out points for using the software, and you can exchange those points for gear, games, swag, and more.

### CURRENCY MINING

AMD cards are better for currency mining than Nvidia cards for several reasons, but their dominance is not in question. The most basic reason is the algorithms used in currency mining favor the GCN architecture, so much so that AMD cards are usually up to five times faster in performing these operations than their Nvidia equivalent. In fact, the mining craze has pushed the demand for these cards is so high that there's now a supply shortage.

# ALL THE CARDS, SIDE BY SIDE

## SPECIFICATIONS

| | MSI Geforce GTX 750 Gaming | GigaByte GeForce GTX 750 Ti | GeForce GTX 650 Ti Boost * | GeForce GTX 660 * | MSI Radeon R7 250 | PowerColor Radeon R7 250X | AMD Radeon R7 260X | Sapphire Radeon R7 265 |
|---|---|---|---|---|---|---|---|---|
| **Price** | $120 | $150 | $160 | $210 | $90 | $100 | $120 | $150 |
| **Code-name** | Maxwell | Maxwell | Kepler | Kepler | Oland | Cape Verde | Bonaire | Curaco |
| **Processing cores** | 512 | 640 | 768 | 960 | 384 | 640 | 896 | 1,024 |
| **ROP units** | 16 | 16 | 24 | 24 | 8 | 16 | 16 | 32 |
| **Texture units** | 32 | 40 | 64 | 80 | 24 | 40 | 56 | 64 |
| **Memory** | 2GB | 2GB | 2GB | 2GB | 1GB | 1GB | 2GB | 2GB |
| **Memory speed** | 1,350MHz | 1,350MHz | 1,500MHz | 1,500MHz | 1,150MHz | 1,125MHz | 1,500MHz | 1,400MHz |
| **Memory bus** | 128-bit | 128-bit | 192-bit | 192-bit | 128-bit | 128-bit | 128-bit | 256-bit |
| **Base clock** | 1,020MHz | 1,020MHz | 980MHz | 980MHz | N/A | N/A | N/A | N/A |
| **Boost clock** | 1,085MHz | 1,085MHz | 1,033MHz | 1,033MHz | 1,050MHz | 1,000MHz | 1,100MHz | 925MHz |
| **PCI Express version** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **Transistor count** | 1.87 billion | 1.87 billion | 2.54 billion | 2.54 billion | 1.04 billion | 1.5 billion | 2.08 billion | 2.8 billion |
| **Power connectors** | N/A | N/A | 1x six-pin | 1x six-pin | N/A | 1x six-pin | 1x six-pin | 1x six-pin |
| **TDP** | 54W | 60W | 134W | 140W | 65W | 80W | 115W | 150W |
| **Fab process** | 28nm | 28nm | 28nm | 28nm | 28nm | 28nm | 28nm | 28nm |
| **Multi-card support** | No | No | Yes | Yes | No | Yes | Yes | Yes |
| **Outputs** | DVI, VGA, HDMI | 2x DVI, 2x HDMI | 2x DVI, HDMI, DisplayPort | 2x DVI, HDMI, DisplayPort | DVI-S, VGA, HDMI | DVI, VGA, HDMI | 2x DVI, HDMI, DisplayPort | 2x DVI, HDMI, DisplayPort |

*Provided for reference purposes.

DUAL-X
DUAL-X

GIGABYTE
WINDFORCE
GIGABYTE

Twin Frozr
msi

# HOW WE TESTED

## We lowered our requirements, but not too much

We normally test all of our video cards on our standardized test bed, which has now been in operation for a year and a half, with only a few changes along the way. In fact, the only major change we've made to it in the last year was swapping the X79 motherboard and case. The motherboard had endured several hundred video-card insertions, which is well beyond the design specs. The case had also become bent to the point where the video cards were drooping slightly. Some, shall we say, "overzealous" overclocking also caused the motherboard to begin behaving unpredictably. Regardless, it's a top-tier rig with an Intel Core i7-3960X Extreme processor, 16GB of DDR3 memory, an Asus Rampage IV Extreme motherboard, Crucial M500 SSD, and Windows 8 64-bit Enterprise.

For the AMD video cards, we loaded Catalyst driver 14.1 Beta 1.6, as that was the latest driver, and for the Nvidia cards, we used the 334.89 WHQL driver that was released just before testing began. We originally planned to run the cards at our normal "midrange GPU" settings, which is 1920x1080 resolution with maximum settings and 4X AA enabled, but after testing began, we realized we needed to back off those settings just a tad. Instead of dialing it down to medium settings, though, as that would run counter to everything we stand for as a magazine, we left the settings on "high" across the board, but disabled AA. These settings were a bit much for the lower-end cards, but rather than lower our settings once again, we decided to stand fast at 1080p with high settings, since we figured that's where you want to be gaming and you deserve to know if some of the less-expensive cards can handle that type of action.

# MANTLE REVIEWED

## A word about AMD's Mantle API

AMD's Mantle API is a competitor to DirectX, optimized specifically for AMD's GCN hardware. In theory, it should allow for better performance since its code knows exactly what hardware it's talking to, as opposed to DirectX's "works with any card" approach. The Mantle API should be able to give all GCN 1.0 and later AMD cards quite a boost in games that support it. However, AMD points out that Mantle will only show benefits in scenarios that are CPU-bound, not GPU-bound, so if your GPU is already working as hard as it can, Mantle isn't going to help it. However, if your GPU is always waiting around for instructions from an overloaded CPU, then Mantle can offer respectable gains.

**Enabling Mantle in Battlefield 4 does provide performance boosts for most configs.**

To test it out, we ran Battlefield 4 on an older Ivy Bridge quad-core, non-Hyper-Threaded Core i5-3470 test bench with the R7 260X GPU at 1920x1080 and 4X AA enabled. As of press time, there are only two games that support Mantle—Battlefield 4 and an RTS demo on Steam named Star Swarm. In Battlefield 4, we were able to achieve 36fps using DirectX, and 44fps using Mantle, which is a healthy increase and a very respectable showing for a $120 video card. The benefit was much smaller in Star Swarm, however, showing a negligible increase of just two frames per second.

We then moved to a much beefier test bench running a six-core, Hyper-Threaded Core i7-3960X and a Radeon R9 290X, and we saw an increase in Star Swarm of 100 percent, going from 25fps with DirectX to 51fps using Mantle in a timed demo. We got a decent bump in Battlefield 4, too, going from 84 fps using DirectX to 98 fps in Mantle.

Overall, Mantle is legit, but it's kind of like PhysX or TressFX in that it's nice to have when it's supported, and does provide a boost, but it isn't something we'd count on being available in most games.

# FINAL THOUGHTS

## If cost is an issue, you've got options

Testing the cards for this feature was an enlightening experience. We don't usually dabble in GPU waters that are this shallow, so we really had no idea what to expect from all the cards assembled. To be honest, if we were given a shot of sodium pentothal, we'd have to admit that given these cards' price points, we had low expectations but thought they'd all at least be able to handle 1920x1080 gaming. As spoiled gamers used to running 2K or 4K resolution, 1080p seems like child's play to us. But we found out that running that resolution at maximum settings is a bridge too far for any GPU that costs less than $120 or so. The $150 models are the sweet spot, though, and are able to game extremely well at 1080 resolution, meaning the barrier to entry for "sweet gaming" has been lowered by $100, thanks to these new GPUs from AMD and Nvidia.

Therefore, the summary of our results is that if you have $150 to spend on a GPU, you should buy the Sapphire Radeon R7 265, as it's the best card for gaming at this price point, end of discussion. OK, thanks for reading.

Oh, are you still here? OK, here's some more detail. In our testing, the Sapphire R7 265 was hands-down the fastest GPU at its price point—by a non-trivial margin in many tests—and is superior to the GTX 750 Ti from Nvidia. It was also the only GPU to come close to the magical 60fps we desire in every game, making it pretty much the only card in this crowd that came close to satisfying our sky-high demands. The Nvidia GTX 750 Ti card was a close second, though, and provides a totally passable experience at 1080p with all settings maxed. Nvidia's trump card is that it consumes less than half the power of the R7 265 and runs 10 C cooler, but we doubt most gamers will care except in severely PSU-constrained systems.

> “
> THE BARRIER TO ENTRY FOR "SWEET GAMING" HAS BEEN LOWERED BY $100, THANKS TO THESE NEW GPUS FROM AMD AND NVIDIA

Moving down one notch to the $120 cards, the GTX 750 and R7 260X trade blows quite well, so there's no clear winner. Pick your ecosystem and get your game on, because these cards are totally decent, and delivered playable frame rates in every test we ran.

The bottom rung of cards, which consists of the R7 250(X) cards, were not playable at 1080p at max settings, so avoid them. They are probably good for 1680x1050 gaming at medium settings or something in that ballpark, but in our world, that is a no-man's land filled with shattered dreams and sad pixels.

### BENCHMARKS

| | **Nvidia GTX 750 Ti (reference)** | **Gigabyte GTX 750 Ti** | **MSI GTX 750 Gaming** | **Sapphire Radeon R7 265** | **AMD Radeon R7 260X** | **PowerColor Radeon R7 250X** | **MSI Radeon R7 250 OC** |
|---|---|---|---|---|---|---|---|
| **Driver** | 334.89 | 334.89 | 334.89 | 14.1 v1.6 | 14.1 v1.6 | 14.1 v1.6 | 14.1 v1.6 |
| **3DMark Fire Storm** | 3,960 | 3,974 | 3,558 | **4,686** | 3,832 | 2,806 | 1,524 |
| **Unigine Heaven 4.0 (fps)** | **30** | **30** | 25 | 29 | 23 | 17 | 9 |
| **Crysis 3 (fps)** | 27 | 25 | 21 | **32** | 26 | 16 | 10 |
| **Far Cry 3 (fps)** | **40** | **40** | 34 | **40** | 34 | 16 | 14 |
| **Tomb Raider (fps)** | 30 | 30 | 26 | **36** | 31 | 20 | 12 |
| **CoD: Ghosts (fps)** | 51 | 49 | 42 | **67** | 51 | 28 | 22 |
| **Battlefield 4 (fps)** | 45 | 45 | 32 | **49** | 40 | 27 | 14 |
| **Batman: Arkham Origins (fps)** | **74** | 71 | 61 | 55 | 43 | 34 | 18 |
| **Assassin's Creed: Black Flag (fps)** | 33 | 33 | 29 | **39** | 21 | 21 | 14 |

Best scores are bolded. Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an Asus Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8. All games are run at 1920x1080 with no AA except for the 3DMark tests.

# GET NASty

## MULTI-BAY NAS SHOOTOUT

**BY PAUL LILLY**

There's nothing quite like having a system fail and then realizing you hadn't backed up your data. In the back of your mind, you always knew this day might come, but procrastination and poor planning has caught you with your pants down, and you have no one to blame but yourself. "Never again!" you shout, but as your anger eventually subsides, so does your impetus to do something about it.

You don't have to be *that* guy. A little wherewithal, a minor amount of planning, and a network-attached storage (NAS) appliance will give you peace of mind—and keep your data safe. Owning a NAS box is an excellent way to keep your files organized, backed up, and readily available not just from your own PC, but over your entire network. That includes connected devices such as your smartphone, tablet, game console, and who knows, maybe even your toaster by the time you read this.

We've rounded up a collection of five multi-bay NAS boxes, one each from Western Digital, QNAP, Buffalo, Netgear, and LaCie. Each one will happily back up your data to multiple hard drives configured in various levels of RAID, but they're also capable of much more. We'll evaluate how easy (or difficult) each one is to set up and use, how they perform, and what kinds of special or unique functionalities they bring to the table, beyond simple storage chores. Put the kids to bed, folks, things are about to get NASty!

WD
My Cloud
EX4
4
QNAP
ENTER
SELECT
STATUS USB LAN
POWER
COPY
Act
1 2
Backup
NETGEAR

# GETTING TO KNOW NAS

## A primer on NAS and how it can benefit you

Let's be honest: The topic of backing up storage isn't particularly sexy or glamorous, though it is essential. At some point or another, your current storage device will fail; when it does, will you be prepared? Without a backup in place, you can kiss those vacation photos and home videos of junior taking his first steps goodbye. Once you've gotten over the emotional trauma and guilt of having lost all those digitally preserved memories, you can begin thinking of a way to tell your boss that the report you were working on for that multi-million-dollar client is going to be late—very late. There goes that promotion!

One way to avoid these situations is to back up your data to a NAS appliance. In its most basic form, a NAS is any storage device attached to your network that you can access from other PCs and connected devices, hence the reason it's called "network-attached storage." It's your own personal server—your own cloud, if you will—that's responsible for storing and sharing files. A NAS box is especially handy if you have multiple connected devices in your home, including mobile gadgets like smartphones and tablets.

Not everyone will benefit the in same way from a NAS box. For example, if you only have one or two PCs in your home and don't care about backing up data from or streaming to other devices, a hard drive or even a USB flash drive connected to your router's USB port might be all you need. However, you'll miss out on the other benefits NAS boxes offer, one of the most important of which is redundancy. A basic feature of any multi-bay NAS box is RAID (Redundant Array of Independent/Inexpensive Disks) support. Depending on the level of RAID you select, if one of the drives in a multi-bay NAS appliance fails, your data remains safe. You'll want to replace the faulty drive as soon as possible, but unlike relying on a single drive—whether it's connected to a router or as a storage partition on your system's internal hard drive or solid-state drive—your backed-up files don't enter the digital afterlife if a drive gives up the ghost.

There are distinct advantages to using an in-home NAS box versus trusting your data to a third-party cloud provider, too. For one, you don't have to worry about subscription fees. Even though some cloud-storage options are free, they're typically capped and limited in functionality. On top of that, you can't always be sure a free service will remain that way—SugarSync, for example, recently transitioned to a paid-only service. NAS boxes come with an up-front cost, but you own the hardware.

We'd also be remiss to ignore the elephant in the room. The more we learn about our government's spying tactics, the less likely it seems we can totally avoid the watchful eye of Big Brother, though that doesn't mean we have to make it overly easy for Uncle Sam to sneak a peek at our files. Anything sent over the Internet is susceptible to spying, not to mention how much cooperation—forced or otherwise—a third-party cloud provider is offering up. It's not just the government, either—hackers can make off with your data and your credit card details by breaking into a cloud provider's database. To top it off, access to your backed-up data in the cloud is reliant on both your ISP and your cloud provider; if there's an outage on either end, you won't have access to that data.

In short, there are a number of benefits to owning a multi-bay NAS box, but how do you choose one? The answer to that question really depends on how much functionality you want for your dollar. Performance also comes into play. In our experience, machines with bigger, faster processors perform better and are more responsive. There's a lot of overhead to deal with, plus the fact that today's NAS boxes are smarter and more capable than ever.

One final word about NAS setup: For irreplaceable files and other important data, you should still maintain a separate, off-site backup in case of a fire, flood, or other disaster.

## R.I.P. WINDOWS HOME SERVER

We were disappointed when Microsoft decided to discontinue its Windows Home Server OS—it worked wonderfully with other Windows products—though, truth be told, Redmond had already stuck a fork in the software by removing its nifty drive-extender technology from WHS 2011, the last version ever available. The drive-extender function was groovy because it allowed users to add, upgrade, and replace HDDs without losing their data. For example, if a user was running out of storage space on a setup containing four 1TB hard drives, he could swap out one of the drives and replace it with a 3TB HDD without skipping a beat.

As much as we liked WHS, it never quite caught on with most mainstream users. Microsoft had the almost impossible task of trying to explain why a user should spend several hundred dollars rolling his own mini home server, when the average buyer was already reluctant to spend more than a few Benjamins on a new PC. The value proposition became even harder to explain as new PC prices started to nose dive in recent years—you can run out to Best Buy and snag a touchscreen laptop with Windows 8 for less than $400.

lenovo
lenovo
ideacentre

**All of the major OEMs have abandoned the now-dead Windows Home Server 2011 OS.**

# BUFFALO LINKSTATION 420

## Low-frills backup on a budget

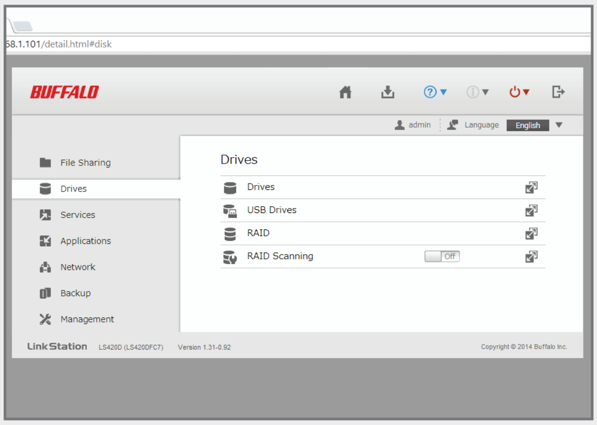
**OUT OF THE FIVE** NAS boxes represented in this roundup, Buffalo's LinkStation 420 is the least expensive. It costs around $300 (street) for a unit prepopulated with 4TB of storage, which is how it was sent to us. Other storage capacities include 2TB, 6TB, and 8TB, or you can opt for a diskless version (421e) for around $120 if you already own hard drives.

This is a two-drive box with support for RAID 0 and RAID 1. If you opt for a version with storage, hard drives will occupy both bays—the 8TB model sports a pair of 4TB drives, while the 2TB model uses two 1TB drives. Since it's only a two-bay NAS box with no JBOD support, you'll want to decide carefully on your current and future storage needs.

Buffalo attempts to win over consumers by claiming transfer speeds of up to 100MB/s, and in some instances, you'll hit and even surpass the century mark. The LinkStation 420 especially excels at small file transfers, though performance depends on how you have it configured. Out of the box, Buffalo defaults to RAID 0. This type of RAID doesn't offer any redundancy and instead splits data across multiple disks for faster throughput. The major downside to this approach is that if one of the drives fails, you lose all your data. In a RAID 1 array, your data is duplicated across both drives and is still retrievable if one of the drives bites the dust.

Surprisingly, switching to a RAID 1 configuration didn't have a big impact on performance (though the task of switching RAID modes takes several hours to complete). Transferring 1GB of music files from our test bed to the LinkStation took 25 seconds when configured in RAID 0, and 27 seconds in RAID 1. That's how it played out across the board: only minor performance hits, both in real-world and synthetic benchmarking.

While the RAID configuration didn't have much of an impact on performance, turning on DLNA did. With DLNA streaming enabled, it took over half a minute longer to copy a 3GB collection of VOB files to the LinkStation versus disabling the streaming service. We suspect that the combination of a 1.2GHz single-core ARM processor and 512MB of RAM is like asking the LinkStation to chew bubble gum and walk at full speed at the same time, so it gets tripped up trying to do both.



**Buffalo's interface is sparse because there's not a ton of options to play around with.**

Navigating the web interface is pretty straightforward, in part because the LinkStation lacks some of the advanced features found on higher-end (and higher-priced) NAS appliances. Whereas QNAP takes a kitchen sink approach with the TurboNAS TS-470, Buffalo sits way on the other side of the spectrum with a NAS box that offers users little more than the basics. There's no app support either, so what you see is what you get.

Buffalo at least covers the bare essentials. The LinkStation supports BitTorrent, you can stream media via DLNA or iTunes, and you can configure FTP settings. For backup chores, it supports Time Machine for Macs and comes with NovaBackup Professional software for Windows. It also supports printer sharing and external storage expansion, but only one or the other at a time via the single USB 2.0 port on the back.

As a basic backup solution, the LinkStation is an attractive bargain. The big upside is you're not being forced to pay a premium for additional features you may never use or care about, though if you want more from a NAS appliance than simple backups, you'll need to pony up for a higher-priced alternative with more bells and whistles.

**VERDICT**

**7**

**Buffalo LinkStation 420 w/4TB**

$300 (street), www.buffalotech.com

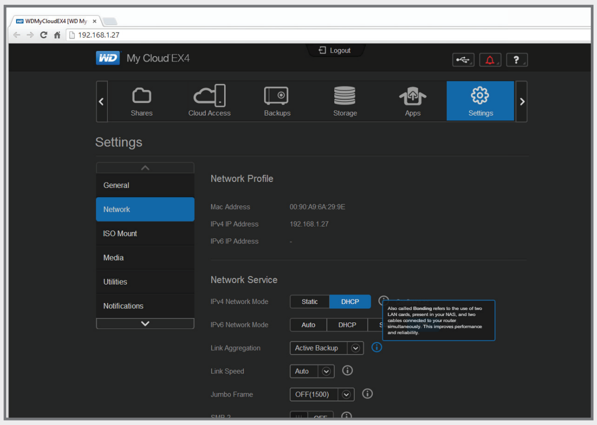
# WD MY CLOUD EX4

## A business-savvy box that's consumer-friendly, too

**WESTERN DIGITAL** infused the My Cloud EX4 with features that will appeal to both home consumers and small-business owners alike. This means home consumers won't have to buy a brand-new NAS if their needs grow down the line, while business users have a relatively affordable option that's easy to use. For example, most home consumers won't give two spits about the dual LAN ports, but with link aggregation and failover support, a business user can tap into the two ports for additional performance or as protection against a downed connection or cable. If a connection fails for any reason, the EX4 switches to the other connection without skipping a beat. The same goes for the redundant DC power connections on the back of the box, though WD only provides a single external power supply—you'll have to buy a second one if you're concerned about it going bad, or as a precaution against little Billy tripping over the power cord.

The EX4's cloud-based GUI is the sleekest of the bunch and extremely user-friendly. That's to say you don't need to be a total networking nerd to navigate the interface and configure tasks like automatic backups, though if you want to dive a little deeper into your LAN, you'll find a spattering of fine-grain tools to play around with. Many options are accompanied by an information box with brief explanations of their functions. These range from mildly helpful to insultingly obvious—in the Network UPS section, the help box offers clarification on Master and Slave models (that's helpful), whereas the help box next to the On/Off switch for the WebDAV Service simply states "Enable or disable the WebDAV service" without explaining what it is or does (gee, thanks!).

The EX4 is a four-bay box with support for RAID 0, RAID 1, RAID 5, and RAID 10, along with spanning and JBOD. Our unit came with 8TB of storage spread across four 2TB WD Red NAS drives spinning at 5400 RPM; it's also offered in 12TB and 16TB capacities, or sans HDDs if you want to bring your own to the NAS party. A nice convenience of the EX4 is that drives pop right in—no screwdriver needed. Perhaps too convenient, however, are the lack of drive locks. If little Billy isn't tripping over the power cord, he could still wreak havoc by yanking out a drive and hiding it somewhere in the house.



Network Profile

Mac Address 00:90:A9:6A:29:9E
IPv4 IP Address 192.168.1.27
IPv6 IP Address -

Network Service

IPv4 Network Mode DHCP
IPv6 Network Mode
Link Aggregation Active Backup
Link Speed Auto
Jumbo Frame OFF(1500)

Also called **Bonding** refers to the use of two LAN cards, present in your NAS, and two cables connected to your router simultaneously. This improves performance and reliability.

**Confused about a term? Some of the information icons contain helpful explanations.**

We tested the EX4 in RAID 5, RAID 1, and RAID 0 modes, though changing it up didn't seem to impact performance all that much. In our file transfer tests, the EX4 generally lagged behind the competition whether we were dealing with smaller-sized files or larger VOB files. This was especially disappointing in RAID 0—given the nominal gains in performance, it's just not worth the added risk of data loss versus running RAID 1 or RAID 5.

Enabling DLNA also proved a burden for the EX4, which is something we witnessed to some extent on every NAS box tested here. The good news for WD is that the impact was fairly minor on our real-world tests, though the EX4 was one of the slower-performing boxes to begin with.

So, where does leave us? First and foremost, it leaves us wishing the EX4 had a little more pep in its step, which would make it a clear favorite. However, what it lacks in sheer speed it makes up for in features and ease-of-use. If you can live with slower transfers, the EX4 is a fantastic buy for both home and business users.

**VERDICT** 8

**WD My Cloud EX4 w/8TB**

$750, www.wd.com

# NETGEAR READYNAS RN102

## Fast and compact

Act
1 2
Backup
NETGEAR
NETGEAR

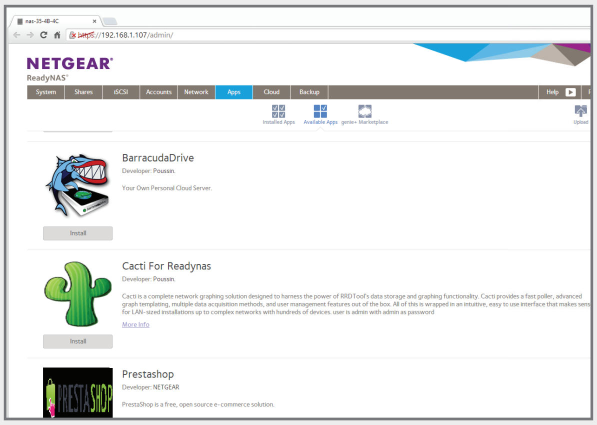
**IF THERE'S ONE** company we thought might have a leg up in this competition, it's Netgear, which has spoiled us with its high-performance wireless routers like the WNDR4500 and R7000 (otherwise known as the Nighthawk). The difference here is those are both top-shelf models, whereas the RN102 is part of the entry-level 100 series in the ReadyNAS product line released last year.

Some of Netgear's NAS boxes are a bit complicated for the average user, so with the ReadyNAS line, the company went back to the drawing board and rebuilt its Linux-based platform from the ground up. The result is ReadyNAS OS 6, a clean and open platform that looks slightly unfinished.

Powering the RN102 is a 1.6GHz single-core ARM-based Marvell Armada 370 processor and 512MB of RAM, the exact same combination Buffalo chose for its LinkStation 420. Both are compact boxes with two drive bays, though Netgear's carries a slightly larger footprint (3.97x5.59x8.66 inches versus 3.43x5.02x8.07 inches). Nevertheless, the RN102 can be tucked discretely away under the bed or in the corner of a closet. It also offers more connectivity options than the LinkStation—two USB 3.0 ports, a USB 2.0 port, eSATA, and a Kensington lock, compared to just a lonely USB 2.0 port.

With a street price of around $340, the RN102 is wedged between Buffalo's LinkStation and LaCie's 2big NAS boxes, which sell on the street for around $250 and $400, respectively. Why not go for the cheapest of the bunch and call it a day? In addition to having more connectivity options than the LinkStation, Netgear's NAS box is made with metal instead of plastic. We didn't have the same nervousness yanking drives out of the toolless caddies in the RN102, whereas the LinkStation's plastic pull-tabs feel chintzy in comparison.

The RN102 supports up to 8TB. Our system came stuffed with a pair of Toshiba 1TB hard drives (7,200rpm, 32MB cache). By default, the RN102 configures itself in RAID 1 with Netgear's proprietary X-RAID technology, a single-volume architecture that allows you to add storage space without reformatting your drives. Toggling out of X-RAID gives you the option of choosing other configurations—RAID 0, 1, 5, 6, and 10, as well as JBOD. That's a pretty robust range for an entry-level box.



BarracudaDrive
Developer: Poussin.
Your Own Personal Cloud Server.

Cacti For Readynas
Developer: Poussin.
Cacti is a complete network graphing solution designed to harness the power of RRDTool's data storage and graphing functionality. Cacti provides a fast poller, advanced graph templating, multiple data acquisition methods, and user management features out of the box. All of this is wrapped in an intuitive, easy to use interface that makes sens for LAN-sized installations up to complex networks with hundreds of devices. user is admin with admin as password
More Info

Prestashop
Developer: NETGEAR
PrestaShop is a free, open source e-commerce solution.

**Netgear's app selection isn't robust, but there are a few good ones.**

We tested both RAID 0 and RAID 1 configurations. Performance was a mixed bag between the two, though generally fast at every turn. The RN102 approached or surpassed the 100MB/s mark in several tests and posted the highest read score in CrystalDiskMark. It also transferred large VOB files faster than both other two-bay NAS boxes. Unsurprisingly, enabling DLNA slowed things down a bit.

The RN102 is capable of more than simple file transfers—it also supports a small but growing number of apps. This isn't so much a selling point as it is a bonus, at least until developers step to the plate with more app options. As it stands, there are just a handful, one of the more interesting ones being a surveillance app (ReadySurvelliance) that turns the RN102 into a Network Video Recorder (NVR). Using the app and an IP camera, of which there are over 1,000 supported models, you can keep tabs on your business or home remotely from your iPhone or Android smartphone.

Though Netgear markets the RN102 as an entry-level NAS appliance, it comes with a surprising amount of features and solid performance, to boot. Buffalo still has Netgear beat on price, but the RN102's superior construction, flexibility, and performance makes it easier to recommend.

**VERDICT**
**8**

**Netgear ReadyNAS RN102 w/2TB**

$340 (street), www.netgear.com

# LACIE 2BIG NAS

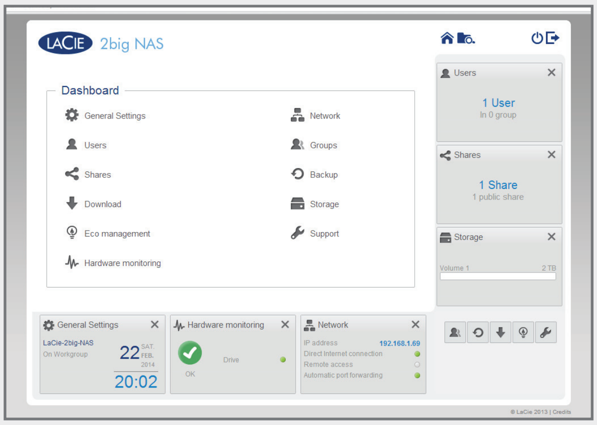
## Small, stylish, and sturdy storage

**IT'S A BIT IRONIC** that LaCie continues to attach the "2big" moniker to this line of NAS appliances, a naming scheme that belies its compact design. But that doesn't mean it will go unnoticed by visitors if you leave it out in the open. On the contrary, LaCie's 2big NAS wins style points for its refreshingly unique design. Whereas most NAS boxes are pretty plain, the 2big NAS looks like a giant heatsink ripped out of an alien spaceship, with a glowing blue orb near the top that gives the box a bit of sci-fi flair. It's also functional as a physical button and an indicator of drive health. Solid blue is what you want to see—it means everything is normal. A blinking blue LED indicates it's busy with an activity, while blue and red blinking means it's building a RAID array or updating its software. What you don't want to see is a blinking red LED, which is a warning sign that something's wrong (high temps or a degraded RAID array), and you really hope to avoid a solid red LED, which indicates a critical error. You can disable the LED through software if you don't care for the persistent mood lighting, especially if you plan to plop the 2big in your bedroom, but events triggering a red alert will still turn on the LED.

LaCie is the only company in this roundup to include several different power adapters. Most civilians won't care, but if you rack up frequent flier miles like a kid collecting candy on Halloween, you can take the 2big almost anywhere in the world and still have an appropriate power cord to fire it up.

The 2big is yet another NAS box with a single-core ARM processor inside, though it's clocked at 2GHz like WD's entry. However, LaCie skimped on RAM, with just 256MB on board, the least amount of any NAS box reviewed here. Connectivity options are also a bit on the sparse side—there's a single USB 2.0 port and an eSATA port, and of course, a Gigabit LAN to plug into your network. To LaCie's credit, the 2big came with the longest Ethernet cable, giving users a bit more flexibility in terms of placement.

LaCie's arrangement of the 2big's web-based dashboard is interesting. There are 11 main categories to browse—General Settings, Users, Shares, Network, and so forth—all of which are accessible from the main window. To the right and underneath are room for three tiles with a bit of expanded info. For example, the General Settings tile displays the date, time, and which network the 2big is connected to, while the Storage tile shows how much space is left. Overall, it's pretty straightforward and easy to get where you're going. You can't dig as deep as you can with some of the other NAS boxes, though, nor does the 2big support third-party apps.



1 User
In 0 group

1 Share
1 public share

Volume 1 2 TB

LaCie-2big-NAS
On Workgroup
22 SAT. FEB. 2014
20:02

OK
Drive

IP address 192.168.1.69
Direct Internet connection
Remote access
Automatic port forwarding

© LaCie 2013 | Credits

**Taking a page from Windows 8, LaCie lines the main section of the UI with customizable tiles.**

When the rubber hit the road, the 2big was never the fastest, though it typically came in second or third in most benchmarks. Read speeds are a bit on the slow side, and with DLNA enabled, it took nearly twice as long to copy VOB files from our client PC to the 2big. Performance improves somewhat by switching from RAID 1 to RAID 0, but so does the risk of losing data.

At $400 (both street and MSRP), the 2big is the most expensive of the two-bay boxes in this roundup. We'd be willing to overlook that if it could distance itself from the competition in some way, but with the limited connectivity options and middling performance, it's a tough sell.

**VERDICT**

**6**

**LaCie 2big NAS w/4TB**

$399, www.lacie.com

# QNAP TURBONAS TS-470

## Your storage concierge awaits

**WE'LL BE THE** first to admit that it's not fair to put a $1,000 NAS in the ring with units that cost anywhere from a third to two-thirds the price, but we can only review what's sent to us, and this is it. So, what does a grand get you in NAS-box world?

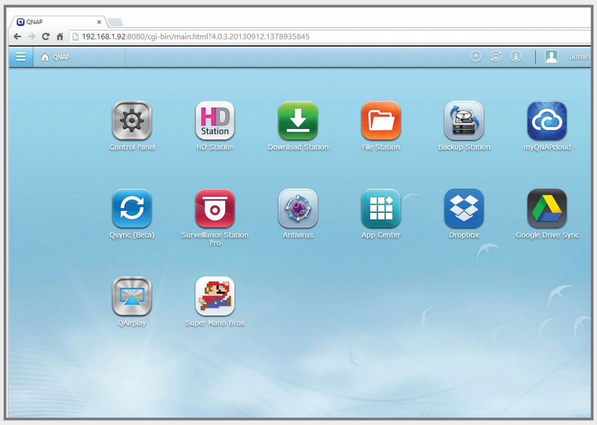
Turns out it's just about everything save for the kitchen sink. Oh, and storage. If you're insulted by the price tag, QNAP adds injury by neglecting to include any hard drives, putting further hurt on your wallet. Hey, at least HDD storage is still fairly cheap these days.

To be fair, the TS-470 isn't just a simple backup device by any means. It's more of a home-networking and storage concierge that's ready to do almost anything you ask of it short of cooking you dinner—but give it time and there might be app for that, too. But before we talk about apps, let's have a look at the hardware.

The TS-470 isn't swinging an ARM chip like the rest of the NAS appliances; it's rocking a 2.6GHz dual-core Intel x86 CPU and 2GB of RAM. It sports four bays, and can expand to a whopping 36 hard drives and 144TB of raw capacity when paired with a couple of dedicated expansion enclosures. There are two 1-Gigabit LAN ports, courtesy of the included PCIe NIC, though you can swap it out for a 10-Gigabit LAN card. You also get two USB 3.0 ports, two USB 2.0 ports (one on the front), two eSATA ports, an HDMI port, both an audio input and output, a Kensington lock, and a built-in infrared receiver for MCE remote control.

On the front is a backlit LCD panel that you control using Enter and Select buttons. You can change certain settings, though not nearly as many as with the web-based UI. Also on the front are power and one-touch copy buttons.

QNAP doesn't use toolless caddies (boo!) though the drive bays do lock in place (yay!). Depending on the number of drives you install, your configuration options include single disk, JBOD, RAID 0, RAID 1, RAID 5, RAID 6, RAID 10, and RAID 5 + Hot Spare. The way RAID 5 + Hot Spare works is one disk is reserved as a spare and used to rebuild the RAID 5 array on the fly if a disk goes bad.



**The QNAP TS-470's web-based UI will feel familar to anyone who's used a smartphone.**

QNAP
POWER
COPY

As you probably surmised from the port selection, the TS-470 has plenty of multimedia mojo. It even supports USB-based TV tuners, though that barely scratches the surface. Dozens of apps exist, including one that emulates Super Mario Bros., in case you're in a nostalgic mood. But it's not all about fun and games—Dropbox is available, and there's an entire category of "Business" apps.

Though there's a dizzying amount of options and functionality to play with, QNAP does an excellent job of presenting it all in a way that doesn't feel daunting. The browser-based UI looks like a typical smartphone or tablet screen, with colorful icons for easy navigation. The Control Panel is where you'll find all the knobs and dials, though it's set up in a way that will never make you feel lost.

The TS-470 isn't just the most flexible NAS box in this roundup, it's also the fastest. It led the way or tied for first in all but two benchmarks, and made a mockery of the competition in our write tests. Surprisingly, the TS-470's superior hardware wasn't enough to offset the performance impact of enabling DLNA, but it did deal with it better than the others.

It's a shame QNAP doesn't include any storage for the asking price, as that's all that holds us back from giving the TS-470 a Kick-Ass award.

**VERDICT**
**9**

**QNAP TurboNAS TS-470**

$1,000, www.qnap.com

# PERFORMANCE

## Speed does actually matter

To evaluate the performance of each NAS box, we used the drives that each one shipped with, save for QNAP's empty TS-470, which we populated with four Western Digital 2TB Red NAS drives. The real challenge was figuring out which RAID to use, and in the end, we benchmarked each NAS box using RAID 0 and RAID 1. We also repeated each test with DLNA enabled, to see what kind of performance impact it would have.

We used a combination of synthetic and real-world benchmarks to evaluate performance. On the synthetic side, we ran CrystalDiskMark's sequential read/write tests and 4K read/write tests. We also used an older version of ATTO (the newest release doesn't recognize network drives) and plucked the highest read and write scores from each run. For our real-world tests, we recorded how long it took to transfer 1GB of music files from our test PC to NAS and from NAS back to the PC, and then repeated the tests using 3GB VOB files.

Due to space constraints, the scores you see in the benchmark chart represent RAID 1 performance with DLNA disabled, though we looked at the overall picture and considered all scores when evaluating and issuing a verdict for each one. In doing so, the QNAP TS-470 stood out as the clear winner among the bunch. Not only is its feature-set a country mile long, it consistently outpaced all the other NAS boxes in our benchmarks (both synthetic and real-world), sometimes by a wide margin. Its write performance was particularly impressive—measured with ATTO, the TS-470 posted 113.74MB/s, well ahead of Netgear's ReadyNAS RN102, which was a distant second with a score of 80.14MB/s. The TS-470 needed to run circles around the competition to justify its pricing premium—it's $1,000 for the box alone—and it did that throughout the majority of testing.

It was far more difficult determining a second-place finisher. Strictly by the numbers, LaCie's 2big NAS came in second place more times than any other NAS box, but it also posted some disturbingly low scores and took last place in ATTO's read and write runs. Plus, it's the most expensive two-bay NAS box represented here and has limited connectivity options, to boot.

If all you're looking for is a cheap way to back up your data, it's hard to ignore Buffalo's LinkStation 420. It runs about $250 street for 2TB, or you can double up to 4TB for around $300, which, quite frankly, would be the better buy. Either way, it's a relatively cheap and serviceable solution for your backup chores, just don't expect it to impress with a list of tricks it never learned.

In our minds, second place is a toss-up between Netgear's ReadyNAS RN102 and Western Digital's My Cloud EX4. The EX4 has twice as many drive bays (four), a sleek UI, and a great balance of features that home consumers and business users alike will appreciate. It's also a little sluggish, posting scores that qualify for fourth or fifth place finishes in seven out of 10 tests. By comparison, Netgear's ReadyNAS RN102 took first or second place in five of the 10 tests. It's simply the faster box, and while it doesn't offer business-class amenities like dual LAN ports and multiple power ports, it makes up for it with a wide selection of software options (including a growing app store) and RAID configurations, a healthy selection of ports, and metal construction, for less than half the price of WD's My Cloud EX4. If forced at gunpoint to choose between the two, we'd ask the gunman why he's so passionate about NAS boxes, and then we'd tell him to pick up Netgear's ReadyNAS RN102.

### BENCHMARKS

| | Buffalo LinkStation 420 | WD My Cloud EX4 | QNAP TurboNAS TS-470 | Netgear ReadyNAS RN102 | LaCie 2big NAS |
|---|---|---|---|---|---|
| CrystalDiskMark Sequential Read (MB/s) | 64.77 | 72.86 | 75.04 | **106.2** | 74.82 |
| CrystalDiskMark Sequential Write (MB/s) | 72.98 | 69.68 | **110.6** | 47.43 | 72.90 |
| CrystalDiskMark 4K Read (MB/s) | 9.69 | 6.76 | **10.73** | 6.71 | 10.18 |
| CrystalDiskMark 4K Write (MB/s) | 9.02 | 9.82 | **10.21** | 5.43 | 9.89 |
| ATTO Read (MB/s) | 113.98 | 115.95 | **117.47** | 102.52 | 84.14 |
| ATTO Write (MB/s) | 75.72 | 73.74 | **113.74** | 80.14 | 59.52 |
| 1GB Music files PC to NAS (sec) | 27 | 29 | **15** | 28 | 24 |
| 1GB Music files NAS to PC (sec) | 19 | 23 | 26 | **17** | 22 |
| 3GB VOB files PC to NAS (sec) | 59 | 69 | **30** | 56 | 66 |
| 3GB VOB files NAS to PC (sec) | **30** | 39 | **30** | 34 | 34 |

We connected the NAS boxes to an Asus RT-AC66U router and ran benchmarks on a wired client PC consisting of an Intel Core i7-930 processor, Asus P6X38D Premium motherboard, 4GB DDR3/1333 RAM, 240GB OCZ Vertex 3 SSD, AMD Radeon HD 5840 graphics card, and 64-bit Windows 8.1.

# SPEC OFF

## The Big Chart of Specs

**The pricier QNAP TS-470 features every port you'd want on a NAS.**

Choosing a NAS box can be difficult. The first order of business is to decide how many drive bays you need, both now and in the future. This affects both the potential storage capacity and your RAID options—for example, RAID 5 requires at least three disks. More drive bays typically translate into a higher price tag, too.

We also feel it's important to pay attention to the CPU and RAM combo. QNAP's TurboNAS TS-470 is the only one that brought an x86 Intel dual-core processor and 2GB of RAM to the NAS party—every other box wields an ARM-based Marvell Armada 300 series single-core SoC and either 256MB or 512MB of RAM.

Both the Buffalo LinkStation 420 and LaCie 2big NAS sport a single USB 2.0 port, the latter of which also has an eSATA connector. That's about as bare-bones as it gets. QNAP's TurboNAS TS-470 and Netgear's ReadyNAS RN102 offer the most connectivity options, which is something to consider if you plan on attaching external storage or a USB printer. The QNAP TurboNAS TS-470 is especially well equipped for connecting devices—it has an HDMI port, dual LAN ports and power connectors, and even audio ports. It's also the only NAS box in our roundup that's 10-Gigabit ready—you can swap out its NIC for one with 10-Gigabit connectivity.

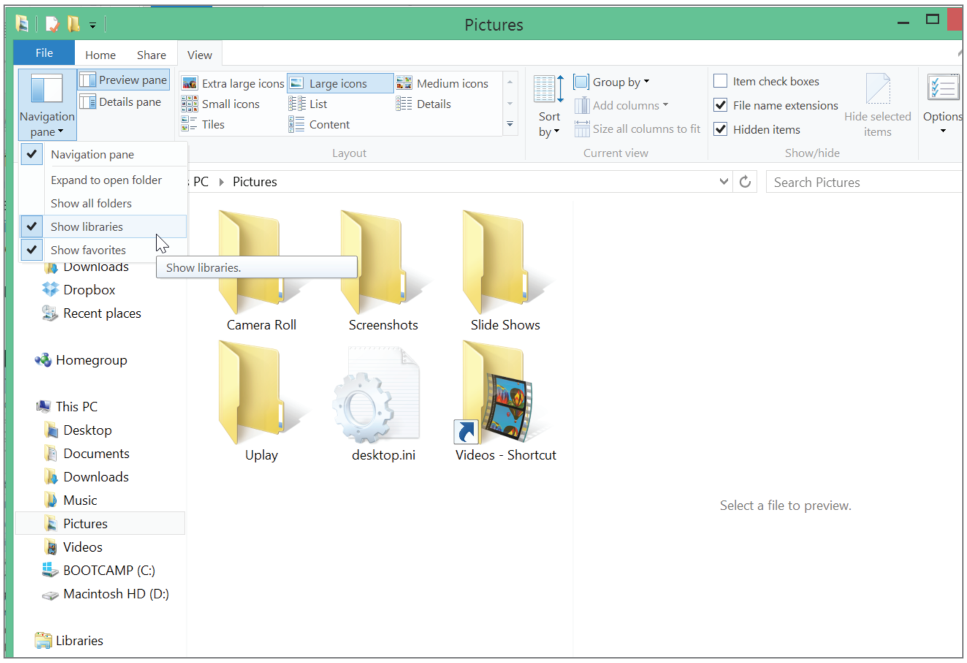
### SPECIFICATIONS

| | WD My Cloud EX4 | QNAP TurboNAS TS-470 | Netgear ReadyNAS RN102 | LaCie 2big NAS | Buffalo LinkStation 420 |
|---|---|---|---|---|---|
| **CPU** | 2GHz single-core ARM | 2.6GHz dual-core Intel | 1.2GHz single-core ARM | 2GHz single-core ARM | 1.2GHz single-core ARM |
| **RAM** | 512MB | 2GB | 512MB | 256MB | 512MB |
| **Drive bays** | 4 | 4 | 2 | 2 | 2 |
| **2.5-inch support** | No | Yes | Yes | No | No |
| **OS** | Linux | QTS 4.0 | ReadyNAS OS 6 | NAS OS 3 (Debian-based Linux) | Linux |
| **Ethernet ports** | 2 (Gigabit) | 4 (Gigabit); 10GbE-ready | 1 (Gigabit) | 1 (Gigabit) | 1 (Gigabit) |
| **Expansion ports** | 2x USB 3.0 | 2x USB 3.0, 3x USB 2.0 | 2x USB 3.0, USB 2.0, eSATA | USB 2.0, eSATA | USB 2.0 |
| **Kingston lock port** | No | Yes | Yes | No | No |
| **DLNA, VMware, etc.** | DLNA, iTunes, Time Machine, CIFS/SMB, AFP, NFSv3, HTTP, FTP, P2P | DLNA, iTunes, Time Machine, AirPlay, VMware, Citrix, Hyper-V, CIFS/SMB, AFP, NFSv3, HTTP, FTP, P2P | DLNA, iTunes, Time Machine, VMWare, Citrix, Hyper-V, TiVO, UPnP, CIFS/SMB, AFP, NFSv3, HTTP, FTP | DLNA, iTunes, Time Machine, CIFS/SMB, AFP, NFSv3, HTTP, FTP, BitTorrent | DLNA, iTunes, Time Machine, CIFS/SMB, AFP, HTTP, FTP, NFS, BitTorrent |
| **RAID** | 0, 1, 5, 10, Spanning, JBOD | 0, 1, 5, 6, 10, 5 + Hot Spare, JBOD | 0, 1, 5, 6, 10, JBOD | 0, 1, JBOD | 0, 1 |
| **HDMI** | No | Yes | No | No | No |
| **Idle power consumption** | 25 watts | 33 watts | 15 watts | 17 watts | 12 watts |
| **Audio ports** | No | 1 Input, 1 Output | No | No | No |
| **Dimensions (W x H x D)** | 6.30 x 8.21 x 8.67 inches | 7.09 x 6.97 x 9.25 inches | 3.97 x 5.59 x 8.66 inches | 3.5 x 7.8 x 6.7 inches | 3.43 x 5.02 x 8.07 inches |
| **Jumbo frame support** | Yes | Yes | Yes | Yes | Yes |
| **Price** | $750 | $1,000 (street) | $340 (street) | $399 (street) | $300 (street) |
| **Verdict (restate)** | 8 | 9 | 8 | 6 | 7 |

# HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

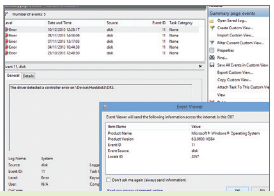
## WINDOWS TIP OF THE MONTH


Pictures
File
Home
Share
View
Navigation pane
Preview pane
Details pane
Extra large icons
Large icons
Medium icons
Small icons
List
Details
Tiles
Content
Layout
Sort by
Group by
Add columns
Size all columns to fit
Current view
☐ Item check boxes
☑ File name extensions
☑ Hidden items
Hide selected items
Show/hide
Options
✓ Navigation pane
Expand to open folder
Show all folders
✓ Show libraries
✓ Show favorites
Show libraries.
PC ▸ Pictures
Search Pictures
Downloads
Dropbox
Recent places
Homegroup
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
BOOTCAMP (C:)
Macintosh HD (D:)
Libraries
Camera Roll
Screenshots
Slide Shows
Uplay
desktop.ini
Videos - Shortcut
Select a file to preview.

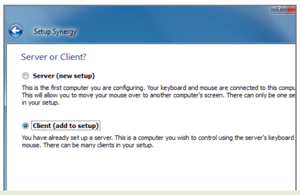
### BRING BACK MISSING LIBRARIES IN WINDOWS 8.1

If you've come to rely on the Libraries feature introduced in Windows 7, you may have been confused to see them disappear in Windows 8.1. Fortunately, they're not gone—just hidden. To reactivate them, click on the View tab in File Explorer, then the button marked Navigation Pane, and click on Show Libraries.

## MAKE - USE - CREATE



**66**
Troubleshoot problems with the Event Viewer



**68**
Share a mouse and keyboard with Synergy

ALEX CASTLE
**CONTRIBUTING EDITOR**

## TIME FOR A TUNE-UP

IT'S BEEN ABOUT a year since I installed Windows 8, and some of the speed and responsiveness that I was so pleased with when I first made the upgrade have started to wear off. Since many *Maximum PC* readers are probably in the same boat, I figured I'd use this month's mini-column as a PSA, and remind you that two quick bits of regular maintenance will keep your PC snappy.

**Check your startup programs.** The biggest culprit for me was a bunch of well-intentioned new startup programs. Going to the Task Manager, clicking the Startup tag, and disabling everything I don't really need as soon as I turn on my PC made a huge difference.

**Clear up disk space.** Run WinDirStat (from www.windirstat.info) to see a graphical representation of what's eating up your hard disk space. I was horrified to find that I was using gigs and gigs of space on PDFs of super-old articles and already-extracted zip files. If you, too, find a trove of unnecessary files (and are certain that they are, in fact, unnecessary), you can do some simple housekeeping to improve your rig's performance.

↘ submit your How To project idea to: comments@maximumpc.com

# Troubleshoot PC Problems with Event Viewer

## YOU'LL NEED THIS

**WINDOWS**
The modern version of the Event Viewer was introduced in Windows Vista, so any recent Windows install will work.

**NOBODY LIKES** an ailing PC, and while Windows has become more reliable with each new release, there are still times when even tools like Action Center and the built-in Troubleshooter can't diagnose a problem and come up with a solution.

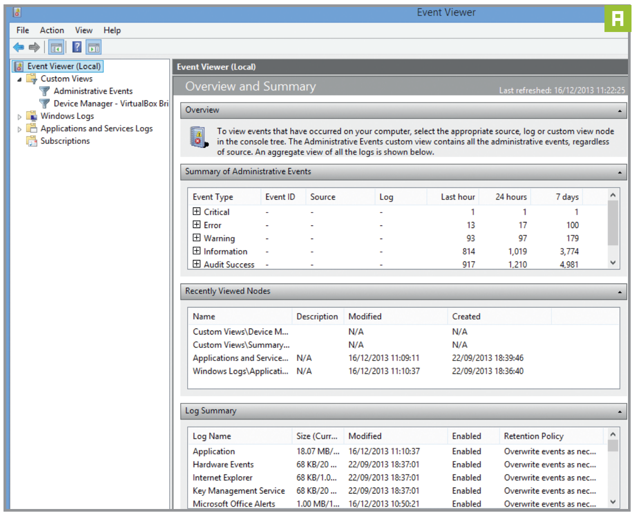
Thankfully, there's a less well known program that can step into the breach: Windows Event Viewer. Windows records a series of logs chronicling everything that's going on under the hood of your PC, including any problems—both visible and hidden away. By carefully examining these logs, you can find out what's causing all kinds of glitches, from obvious—if cryptic—error messages to more vague issues, such as sluggish behavior or periodic freezes. In this tutorial we'll show you how to collect this information, then use it to track down possible solutions to your woes. **–NICK PEERS**

1 **LAUNCH THE EVENT VIEWER** Windows 8 users can launch Event Viewer via the Quick Access Menu, which you can access quickly by pressing Windows + X on your keyboard. Windows 7 and Vista users should press Windows + R to open the Run dialog box, then type **eventvwr**, and press Enter. If you see a prompt from User Account Control, click Yes or Continue.

» The main Event Viewer screen will now appear (**Image A**). After a short pause while the tool analyzes your system, the middle pane here will display three categories of information. You should concentrate on the Summary of Administrative Events at the top, which displays a list of each type of event logged. Pay particular attention to Critical, Error, and Warning events.

» Note how each event type is logged according to the last time it occurred. If the problem you're investigating happened recently, this will help you focus your search on a specific section. Click the section header to expand it and use the annotation to help identify possible events that could potentially be related to the problem you're experiencing.

» Double-click an event from this list to view all instances of it (**Image B**), including the time and date when each instance occurred. This can help link the event to a particular problem. Make a note of the description—the Details tab provides more technical data if you (or someone who's helping troubleshoot your system) need it later.



Last refreshed: 16/12/2013 11:22:25

Overview

To view events that have occurred on your computer, select the appropriate source, log or custom view node in the console tree. The Administrative Events custom view contains all the administrative events, regardless of source. An aggregate view of all the logs is shown below.

Summary of Administrative Events

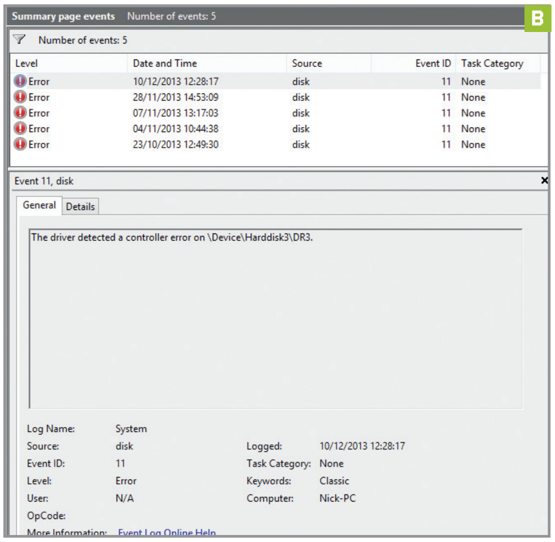
| Event Type | Event ID | Source | Log | Last hour | 24 hours | 7 days |
|---|---|---|---|---|---|---|
| ⊞ Critical | - | - | - | 1 | 1 | 1 |
| ⊞ Error | - | - | - | 13 | 17 | 100 |
| ⊞ Warning | - | - | - | 93 | 97 | 179 |
| ⊞ Information | - | - | - | 814 | 1,019 | 3,774 |
| ⊞ Audit Success | - | - | - | 917 | 1,210 | 4,981 |

Recently Viewed Nodes

| Name | Description | Modified | Created |
|---|---|---|---|
| Custom Views\Device M... | | N/A | N/A |
| Custom Views\Summary... | | N/A | N/A |
| Applications and Service... | N/A | 16/12/2013 11:09:11 | 22/09/2013 18:39:46 |
| Windows Logs\Applicati... | N/A | 16/12/2013 11:10:37 | 22/09/2013 18:36:40 |

Log Summary

| Log Name | Size (Curr... | Modified | Enabled | Retention Policy |
|---|---|---|---|---|
| Application | 18.07 MB/... | 16/12/2013 11:10:37 | Enabled | Overwrite events as nec... |
| Hardware Events | 68 KB/20 ... | 22/09/2013 18:37:01 | Enabled | Overwrite events as nec... |
| Internet Explorer | 68 KB/1.0... | 22/09/2013 18:37:01 | Enabled | Overwrite events as nec... |
| Key Management Service | 68 KB/20 ... | 22/09/2013 18:37:01 | Enabled | Overwrite events as nec... |
| Microsoft Office Alerts | 1.00 MB/1... | 16/12/2013 10:50:21 | Enabled | Overwrite events as nec... |



| Level | Date and Time | Source | Event ID | Task Category |
|---|---|---|---|---|
| Error | 10/12/2013 12:28:17 | disk | 11 | None |
| Error | 28/11/2013 14:53:09 | disk | 11 | None |
| Error | 07/11/2013 13:17:03 | disk | 11 | None |
| Error | 04/11/2013 10:44:38 | disk | 11 | None |
| Error | 23/10/2013 12:49:30 | disk | 11 | None |

The driver detected a controller error on \Device\Harddisk3\DR3.

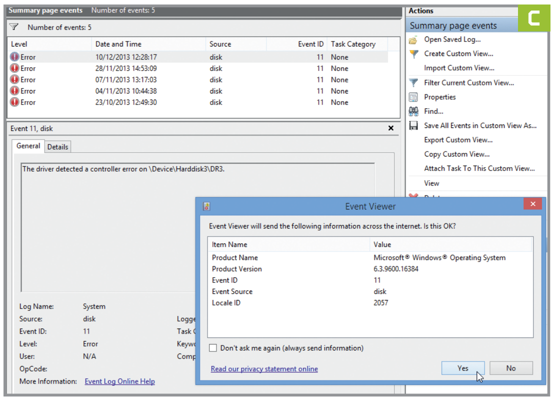
Log Name: System
Source: disk
Logged: 10/12/2013 12:28:17
Event ID: 11
Task Category: None
Level: Error
Keywords: Classic
User: N/A
Computer: Nick-PC
OpCode:
More Information: Event Log Online Help

2 **SEARCH FOR SOLUTIONS** To learn more about the event in question—and possibly track down a solution, if what needs to be done isn't obvious—click the "Event Log Online Help" link at the bottom of the page. Review the information being sent (**Image C**) and click Yes to see if there's more information at TechNet (Microsoft's assistance and resource site for IT professionals).

» Most of the time, TechNet will claim that the page is not found, but don't become disheartened—try typing the Event ID number plus the word **EventID** into the Search box and you'll find links to further information that might help resolve the problem you're investigating, including troubleshooting guides for specific error messages.

» TechNet may return no results for your Event ID, but don't give up yet. Make a note of the Event ID, Source, and description under the General tab, then try typing these into Google and see what results come up. You may come across helpful troubleshooting information via a technical support web page or discussion forum.

» If too few results are returned, try searching for fewer words or omitting either the Source or Event ID from your terms. If your search gives you too many results, try narrowing them down by including more information about your specific problem—version of Windows, hardware device, or software program, for example—then search again and see what comes back.


C
Summary page events
Actions
Summary page events
Open Saved Log...
Create Custom View...
Import Custom View...
Filter Current Custom View...
Properties
Find...
Save All Events in Custom View As...
Export Custom View...
Copy Custom View...
Attach Task To This Custom View...
View
General
Details
Yes
No
Read our privacy statement online
Event Log Online Help

Number of events: 5

| Level | Date and Time | Source | Event ID | Task Category |
|---|---|---|---|---|
| Error | 10/12/2013 12:28:17 | disk | 11 | None |
| Error | 28/11/2013 14:53:09 | disk | 11 | None |
| Error | 07/11/2013 13:17:03 | disk | 11 | None |
| Error | 04/11/2013 10:44:38 | disk | 11 | None |
| Error | 23/10/2013 12:49:30 | disk | 11 | None |

Event 11, disk

The driver detected a controller error on \Device\Harddisk3\DR3.

Log Name: System
Source: disk
Event ID: 11
Level: Error
User: N/A
OpCode:
More Information: Event Log Online Help

Event Viewer

Event Viewer will send the following information across the internet. Is this OK?

| Item Name | Value |
|---|---|
| Product Name | Microsoft® Windows® Operating System |
| Product Version | 6.3.9600.16384 |
| Event ID | 11 |
| Event Source | disk |
| Locale ID | 2057 |

☐ Don't ask me again (always send information)

## 3 FILTER RESULTS AND SET ALERTS

If you're finding it difficult to isolate a specific event that correlates with your problem, you can browse the available logs manually to help narrow your search. Expand "Windows Logs" in the left-hand pane (**Image D**), where you'll find logs organized into categories. Use Applications to search for program-related problems, and System for Windows and hardware.

» Event Viewer records all manner of information, much of which will be irrelevant. Click the "Filter current log" button in the right-hand pane to sort the list in a number of different ways: by the time the event occurred, the type of event (focus on Critical, Error, and Warning), event sources, IDs, keywords, or any combination of these (**Image E**). Click OK when you're done.

» If you want to create a filter across multiple logs, or make a filter that you can access easily in future, click "Create custom view." It's a handy function that works in the same way as the standard filter. To monitor more than one log with your custom view, click the "Event logs" drop-down menu and then tick the logs you wish to include.

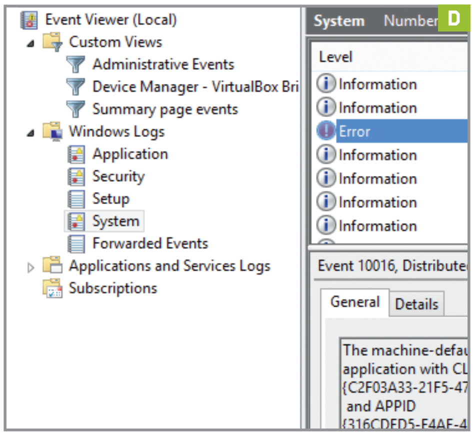
» Click the OK button, then give your custom view a suitably descriptive name, and choose where you want to save it within the Custom Views tree in the left-hand pane. You'll now be able to access this view at any time directly from here—perfect if you're going to be engaging in targeted troubleshooting over an extended period of time.

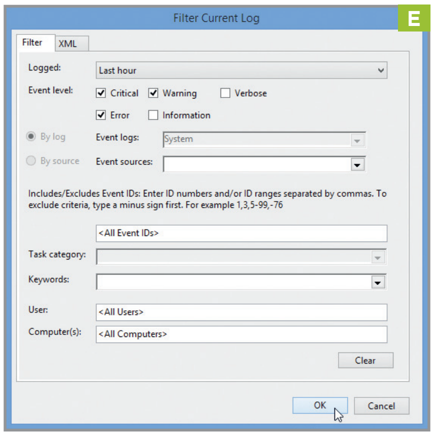
» The Event Viewer also lets you create handy alerts in Windows 7 or Vista that are triggered when specific events occur. This can be a useful tool for troubleshooting if you're trying to find an underlying problem. Once you've located the event that you wish to monitor, start by right-clicking it and choosing the option "Attach task to this event."

» Change the name of the alert to something more descriptive and useful, then click the Next button twice (**Image F**). Tell Event Viewer whether you want to be alerted by email or a pop-up dialog box and click Next. Fill in the details—where to send the email, along with the alert message—and click Next, followed by Finish, and OK.

» Eventually, once you've resolved your Windows issues, you may no longer want that alert popping up. To remove it, open Task Scheduler by clicking Start > All Programs > Accessories > System Tools. Expand Task Scheduler Library > Event Viewer Tasks, right-click on the unwanted alert, and choose Delete, followed by Yes when prompted.

» Now that you've discovered the basics of how Windows Event Viewer works, you can use it to help you track down problems with your computer, giving you the information you need to not just diagnose what's ailing your PC, but also hopefully find a solution to bring it back to good working order. Best of luck with your troubleshooting!


D
Event Viewer (Local)
Custom Views
Administrative Events
Device Manager - VirtualBox Bri
Summary page events
Windows Logs
Application
Security
Setup
System
Forwarded Events
Applications and Services Logs
Subscriptions
System
Number
Level
Information
Information
Error
Information
Information
Information
Information
Event 10016, Distribute
General
Details
The machine-defau
application with CL
{C2F03A33-21F5-47
and APPID
{316CDED5-E4AE-4


E
Filter Current Log
Filter
XML
Clear
OK
Cancel

Logged: Last hour

Event level: ☑ Critical ☑ Warning ☐ Verbose ☑ Error ☐ Information

● By log Event logs: System

○ By source Event sources:

Includes/Excludes Event IDs: Enter ID numbers and/or ID ranges separated by commas. To exclude criteria, type a minus sign first. For example 1,3,5-99,-76

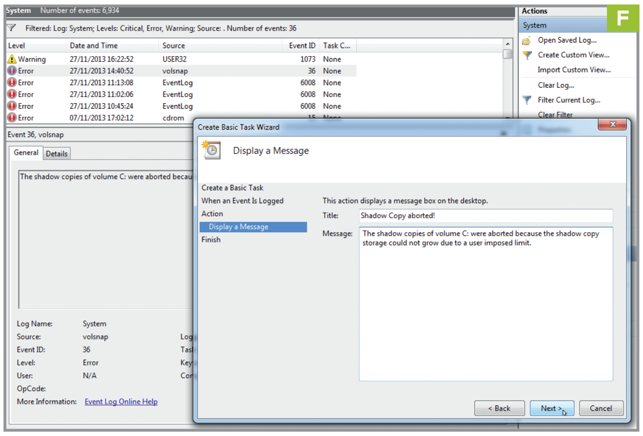
<All Event IDs>

Task category:

Keywords:

User: <All Users>

Computer(s): <All Computers>


F
Actions
System
Open Saved Log...
Create Custom View...
Import Custom View...
Clear Log...
Filter Current Log...
Clear Filter
General
Details
Event Log Online Help
Create Basic Task Wizard
Display a Message
Create a Basic Task
When an Event Is Logged
Action
Display a Message
Finish
< Back
Next >
Cancel

System Number of events: 6,934

Filtered: Log: System; Levels: Critical, Error, Warning; Source: . Number of events: 36

| Level | Date and Time | Source | Event ID | Task C... |
|---|---|---|---|---|
| Warning | 27/11/2013 16:22:52 | USER32 | 1073 | None |
| Error | 27/11/2013 14:40:52 | volsnap | 36 | None |
| Error | 27/11/2013 11:13:08 | EventLog | 6008 | None |
| Error | 27/11/2013 11:02:06 | EventLog | 6008 | None |
| Error | 27/11/2013 10:45:24 | EventLog | 6008 | None |
| Error | 07/11/2013 17:02:12 | cdrom | | |

Event 36, volsnap

The shadow copies of volume C: were aborted becau

Log Name: System
Source: volsnap
Event ID: 36
Level: Error
User: N/A
OpCode:
More Information: Event Log Online Help

This action displays a message box on the desktop.

Title: Shadow Copy aborted!

Message: The shadow copies of volume C: were aborted because the shadow copy storage could not grow due to a user imposed limit.

# Share a Mouse and Keyboard with Synergy

## YOU'LL NEED THIS

**MONITORS**
Each computer requires its own independent display.

**SYNERGY**
Get the software from www.synergy-foss.org/download. You can download it free, or make a small donation to support the developer.

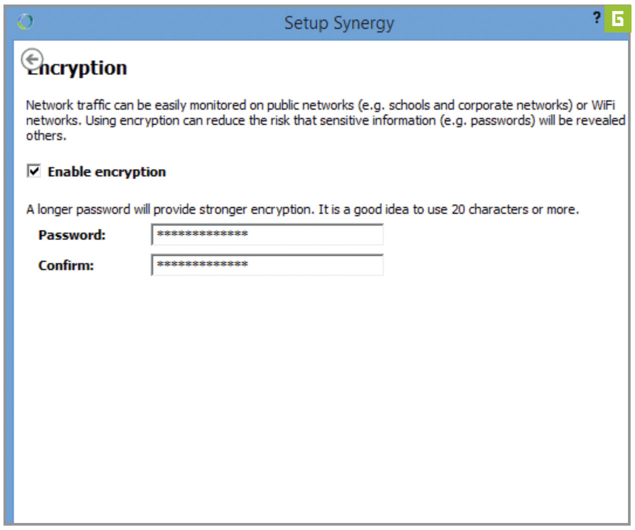
**TOO MANY KEYBOARDS** and mice cluttering your desk? Fed up with your laptop's touchpad and keyboard, but tired of having to unplug your desktop's peripherals to use instead? Often working on two or more PCs or Macs and find it awkward switching from one mouse to another? If so, you need a program called Synergy, which is free to download and use.

Synergy is a clever tool that can free up space on your increasingly cluttered desk by allowing you to use one mouse and keyboard on several computers at once. Synergy also allows you to share the clipboard across your connected PCs, and if you donate and become a premium user, you can easily transfer files between desktops by dragging-and-dropping from one display to another, saving you time as well as valuable real estate. Best of all, Synergy doesn't require any special hardware or even a direct connection from one computer to the other—all it requires is that the computers be on the same wired or wireless network. Find out how to set it up and use it with our step-by-step guide. –**NICK PEERS**

**1** **INSTALL SYNERGY** Install the latest version of Synergy on your server PC—the one with the keyboard and mouse you plan to use. You can download the free version from www.synergy-foss.org, or choose the Premium edition and make a donation to the project. Choose 32-bit or 64-bit, depending on your version of Windows. You'll find versions of Synergy for Mac and Linux here, too. Install the program and click Close.

» Set your language and click Next. You'll now be asked again whether you want to become a premium user to access the latest features. Make your choice and click Next. As this is the first computer you're setting up, choose "Server (new setup)" and click Next to continue. For greater security, tick "Enable encryption" and enter a strong password before clicking Finish (**Image G**). Particularly if you're on an open network, not using encryption could leave your keystrokes visible to prying eyes.

» Switch to another computer or laptop and install Synergy on it following the same process as before. When running the setup wizard after installation, log in with your premium account details (if you chose to make a donation for one), then choose "Client (add to setup)" (**Image H**). Tick "Enable encryption," then type the same password you used in the previous step before clicking Finish.



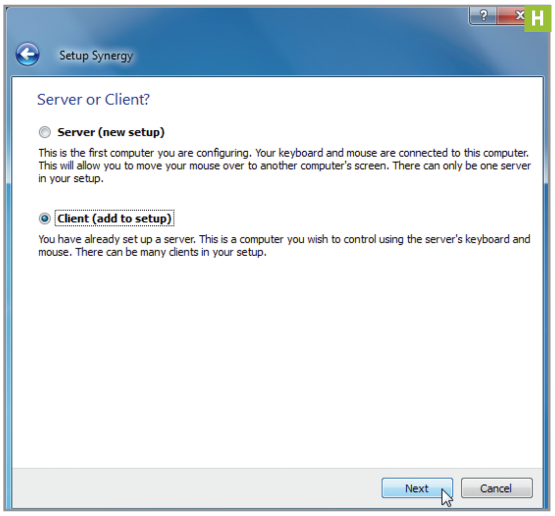
**Encryption**

Network traffic can be easily monitored on public networks (e.g. schools and corporate networks) or WiFi networks. Using encryption can reduce the risk that sensitive information (e.g. passwords) will be revealed others.

☑ **Enable encryption**

A longer password will provide stronger encryption. It is a good idea to use 20 characters or more.

**Password:** **************
**Confirm:** **************



Server or Client?

○ **Server (new setup)**

This is the first computer you are configuring. Your keyboard and mouse are connected to this computer. This will allow you to move your mouse over to another computer's screen. There can only be one server in your setup.

● **Client (add to setup)**

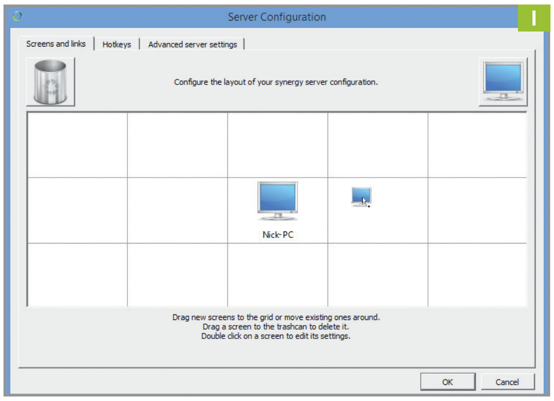
You have already set up a server. This is a computer you wish to control using the server's keyboard and mouse. There can be many clients in your setup.

**2** **CONFIGURE SERVER AND CLIENT** Switch back to your main computer and click the "Configure server" button in the main Synergy window. The "Screens and links" tab is where you tell the Synergy server where your client is physically in relation to it. To link clients to the server, click and hold the mouse on the screen button in the top right, then drag it onto the square that corresponds to your client computer's location (**Image I**). The relation of the two screens in this window will define how you move the mouse from one screen to the other, so make sure it matches your physical setup.

» Double-click the unnamed entry that appears to configure it for your client (**Image J**). Change its name to the screen name displayed in the Synergy window on your client computer and click OK. You can move this entry to another square by simply clicking and dragging it, or delete it by dragging it into the trash can. Once you're sure that the client is set up correctly, click OK.

» Now, click the Start button on your server PC and wait for the "watchdog status: ok" message to be displayed. Switch to your client and click the Start button there, too (**Image K**). If all is well, you should see a "Connected to server" message appear. Now, move your mouse to the edge of the screen corresponding to your physical layout—you should see the pointer jump to the other screen.

» You can now use your mouse and keyboard on the client PC exactly as if they were plugged into it directly. When you want to move control back to your original computer, just move the mouse back to the edge of the screen it came from originally—it will appear back on the original screen. The keyboard's inputs will be received by whichever computer currently has the pointer. You can now minimize or close the Synergy window without losing the connection.

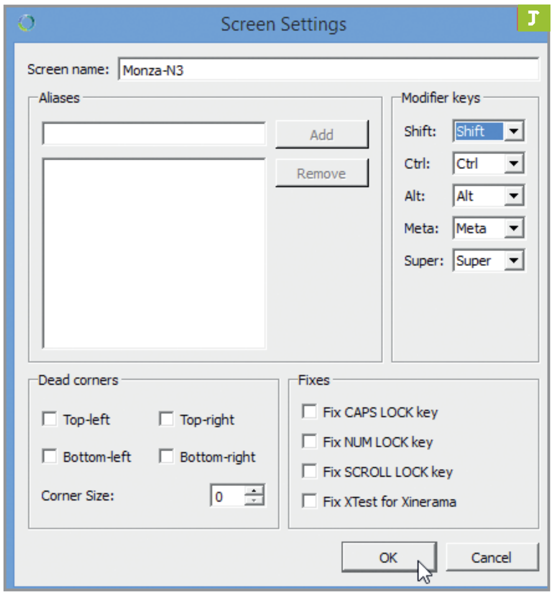

I

Server Configuration

Configure the layout of your synergy server configuration.

Nick-PC

Drag new screens to the grid or move existing ones around.
Drag a screen to the trashcan to delete it.
Double click on a screen to edit its settings.


J

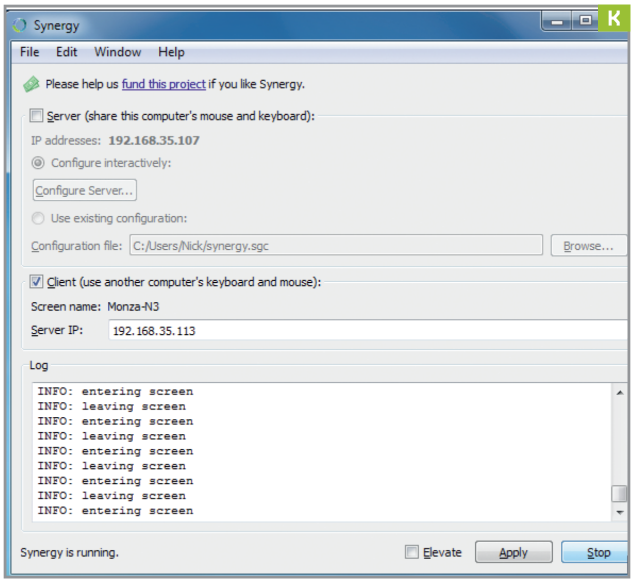
Screen Settings

Screen name: Monza-N3

Modifier keys
Shift: Shift
Ctrl: Ctrl
Alt: Alt
Meta: Meta
Super: Super

Dead corners
☐ Top-left ☐ Top-right
☐ Bottom-left ☐ Bottom-right
Corner Size: 0

Fixes
☐ Fix CAPS LOCK key
☐ Fix NUM LOCK key
☐ Fix SCROLL LOCK key
☐ Fix XTest for Xinerama


K

Synergy

Please help us fund this project if you like Synergy.

☐ Server (share this computer's mouse and keyboard):
IP addresses: 192.168.35.107
● Configure interactively:
○ Use existing configuration:
Configuration file: C:/Users/Nick/synergy.sgc

☑ Client (use another computer's keyboard and mouse):
Screen name: Monza-N3
Server IP: 192.168.35.113

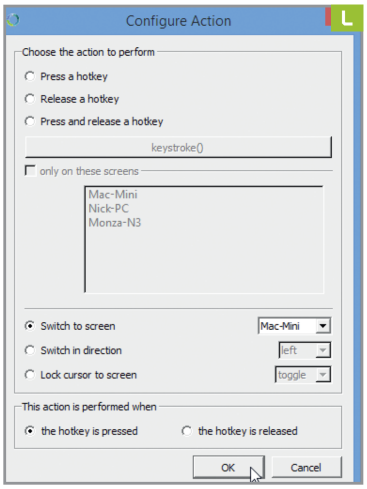
Log
```
INFO: entering screen
INFO: leaving screen
INFO: entering screen
INFO: leaving screen
INFO: entering screen
INFO: leaving screen
INFO: entering screen
INFO: leaving screen
INFO: entering screen
```

Synergy is running. ☐ Elevate

**3 EXTRA FEATURES** Synergy includes some very handy extra features for working on multiple PCs. For example, you can use the shared clipboard to copy text or images (or portions thereof) from one computer to another. Simply select and copy the text or image, then switch to the corresponding application on the other computer and press Ctrl + V to paste it into place.

» If you want to be able to control Synergy itself with keyboard commands, you can set up hotkeys to do so. On your server PC, click "Configure server" and switch to the Hotkeys tab. Click New under Hotkeys, click the "keystroke()" button, and press your chosen key or keys. Only use combinations not used on any of the systems that are using Synergy for sharing. Click OK, select the key, and click New under Actions. Define your chosen action—such as switching to another display—and click OK (**Image I**).

» Congratulations, you've successfully set up keyboard and mouse sharing between two computers. You can now repeat the process for other computers and laptops in your home, including Macs and Linux PCs, using the "Configure server" button on the server to choose which edge or corner of the screen to use to move between them. Your desk will never feel cluttered again!


L

Configure Action

Choose the action to perform
○ Press a hotkey
○ Release a hotkey
○ Press and release a hotkey
keystroke()
☐ only on these screens
Mac-Mini
Nick-PC
Monza-N3

● Switch to screen Mac-Mini
○ Switch in direction left
○ Lock cursor to screen toggle

This action is performed when
● the hotkey is pressed ○ the hotkey is released

# BUILD IT

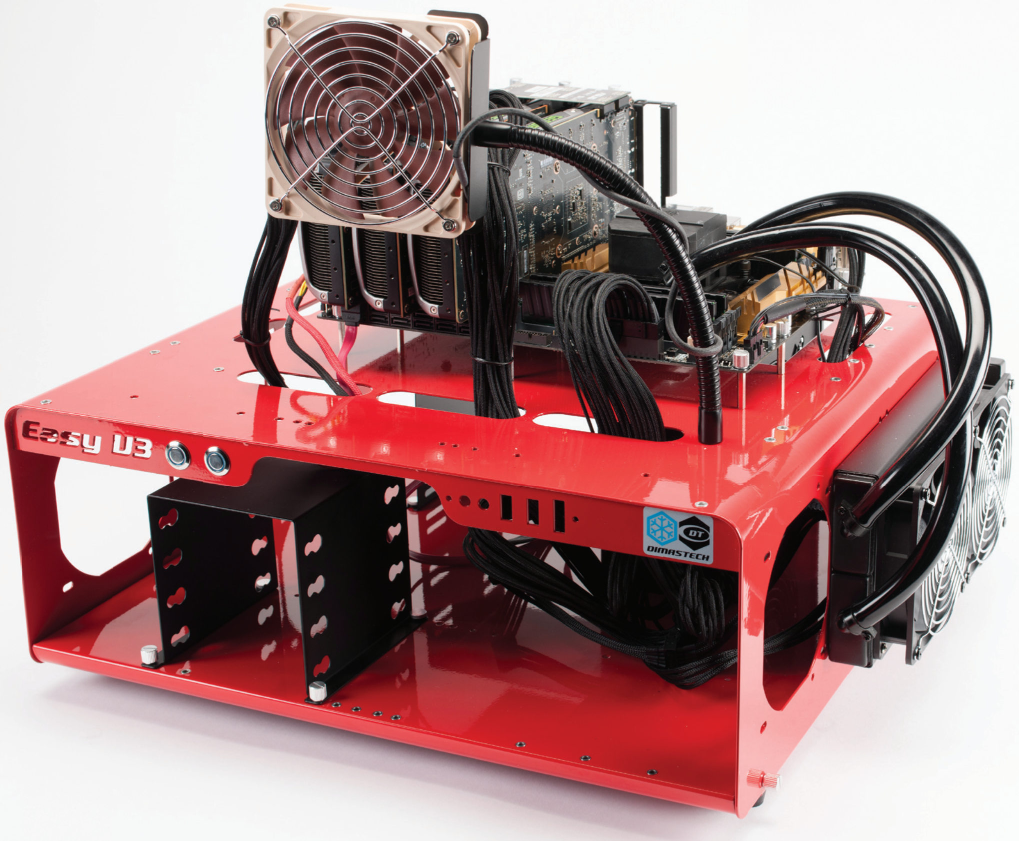
TOM MCNAMARA **ASSOCIATE EDITOR**

# Real-World 4K Gaming Test Bench

This month, we find out what it takes to run games at 4K, and do so using a sweet open-air test bench

LENGTH OF TIME: **2–4 HOURS** | LEVEL OF DIFFICULTY: **MEDIUM**

**THE MISSION** The computer world loves it when specs double from one generation to the next. We've gone from 16-bit to 32-bit, and finally 64-bit computing. We had 2GB RAM sticks, then 4GB, then 8GB. With monitor resolutions, 1920x1080 has been the standard for a while, but we never quite doubled it, as 2560x1600 was a half-step, but now that 4K resolution has arrived, it's effectively been exactly doubled, with the panels released so far being 3840x2160. We know it's not actually 4,000 pixels, but everyone is still calling it "4K." Though resolution is doubled over 1080p, it's the equivalent number of pixels as four 1080p monitors, so it takes a lot of horsepower to play games smoothly. For example, our 2013 Dream Machine used four Nvidia GeForce GTX Titans and a CPU overclocked to 5GHz to handle it. Those cards cost $4,000 altogether though, so it wasn't a scenario for mere mortals. This month, we wanted to see what 4K gaming is like with more-affordable parts. We also wanted to try a distinctive-looking open test bench from DimasTech. This type of case is perfect for SLI testing, too, since it makes component installation and swapping much quicker.



## TRIPLE THREAT

**INSTEAD OF GTX** Titans, we're stepping it down a couple of notches to Nvidia GTX 780s. They provide similar gaming performance, but at half the cost. We're also using "only" three cards instead of four, so the price difference from Dream Machine to this rig is a whopping $2500 (even more if you count the fact that the Dream Machine cards were water-cooled). These cards still need a lot of bandwidth, though, so we're sticking with an Intel LGA 2011 motherboard, this time an Asus X79 Deluxe. It's feature-packed and can overclock a CPU like nobody's business. The X79 Deluxe is running Intel's Core i7-4960X CPU, which has six cores and twelve processing threads. It's kind of a beast. We're cooling it with a Cooler Master Glacer 240L water cooler, which comes with a 240mm radiator.

We'll also need a boatload of power, so we grabbed a Corsair AX1200 PSU which, as its name suggests, supplies up to 1200 watts. It's also fully modular, meaning that its cables are all detachable. Since we're only using one storage device in this build, we can keep a lot of spare cables tucked away in a bag, instead of cluttering up the lower tray.

All of this is being assembled on a DimasTech Easy V3 test bench, which is a laser-cut steel, hand-welded beauty made in Italy and painted glossy red. It can handle either a 360mm or 280mm radiator as well, and it comes with an articulating arm to move a case fan around to specific areas. It seems like the ultimate open-air test bench, so we're eager to see what we can do with it.

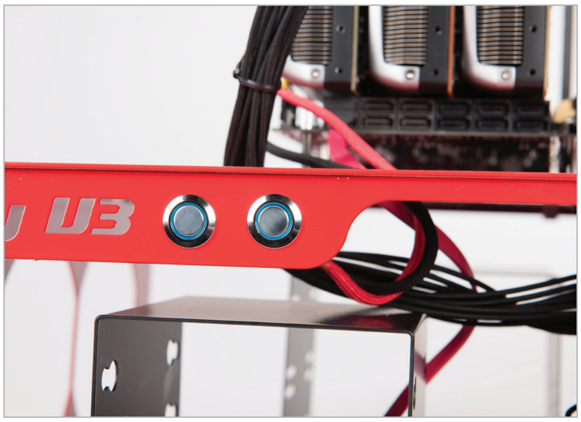
### INGREDIENTS

| | PART | PRICE |
|---|---|---|
| **Case** | DimasTech Easy V3 | **$178** |
| **PSU** | Corsair AX1200 | **$400** |
| **Mobo** | Asus X79 Deluxe | **$350** |
| **CPU** | Intel Core i7-4960X | **$1,000** |
| **Cooler** | Cooler Master Glacer 240L | **$140** |
| **GPU** | 3x Nvidia GeForce GTX 780 | **$1,500** |
| **RAM** | 4x 4GB Corsair Vengeance LP | **$180** |
| **SSD** | Seagate 600 480GB | **$340** |
| **Cable Kit** | Corsair AX1200 individually sleeved modular cables | **$40** |
| **Case Fan** | Noctua NF-P12 | **$23** |
| **OS** | Windows 8.1 64-bit OEM | **$100** |
| **TOTAL** | | **$4,251** |

1

### CASE WORKING

**THE DIMASTECH** Easy V3 comes in separate parts, but the bulk of it is an upper and lower tray. You slide the lower one in and secure it with a bundled set of six aluminum screws. The case's fasteners come in a handy plastic container with a screw-on lid. Shown in the photo are the two chromed power and reset buttons, which are the last pieces to be attached. They have pre-attached hexagonal washers, which can be a bit tricky to remove. We had to use pliers on one of them. You'll need to wire them up yourself, but there's a diagram included. Then, connect the other head to the motherboard's front panel header, which has its own diagram printed on the board.



2

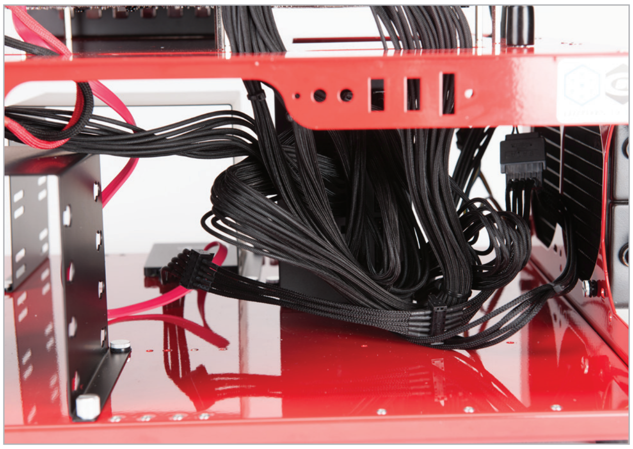
### GETTING TESTY

**UNFORTUNATELY, THE EASY** V3 does not ship with a 2.5-inch drive bay, nor do standard 3.5-inch to 2.5-inch adapters fit inside the bays. If you want to install a solid-state drive, you need to purchase the correctly sized bay or adapter separately from DimasTech. Since this is an open test bench, which is designed for swapping parts quickly, we chose to just leave the drive unsecured. It has no moving parts, so it doesn't need to be screwed down or even laid flat to work properly. We also moved the 5.25-inch drive bay from the front to the back, to leave as much room as possible to work with our bundle of PSU cables. The lower tray has a number of pre-drilled holes to customize drive bay placement. Meanwhile, our power supply must be oriented just like this to properly attach to the case's specified bracket. It's not bad, though, because this positions the power switch higher up, where it's less likely to get bumped accidentally.

## 3

## ABLE CABLES

**THE BEST WAY TO** install a modular power supply is to attach your required cables first. This time, we got a kit from Corsair that has individually sleeved wires. It costs $40, and also comes in red, white, or blue. Each of these kits is designed to work with a specific Corsair power supply. They look fancier than the stock un-sleeved cables, and the ones for motherboard and CPU power are a lot more flexible than the stock versions. All of the connectors are keyed, so you can't accidentally plug them into the wrong socket. We used a few black twist ties to gather in the PCI Express cables.



## 4

## TAKING A STAND(OFF)

**THE EASY V3** comes with an unusually tall set of metal motherboard standoffs. These widgets prevent the motherboard from touching the tray below and possibly creating a short circuit. You can screw these in by hand, optionally tightening them up with a pair of pliers. Once those were in, we actually used some thumbscrews bundled with the case to screw the board down on the standoffs. You can use more standard screws, but we had plenty to spare, and we liked the look. The tall standoffs also work nicely with custom liquid cooling loops, because there is enough clearance to send thick tubing underneath (and we've seen lots of photos on the Internet of such setups). For us, it provided enough room to install a right-angle SATA cable and send it through the oval cut-out in the tray and down to the SSD below.

## 5

## TRIPLE PLAY

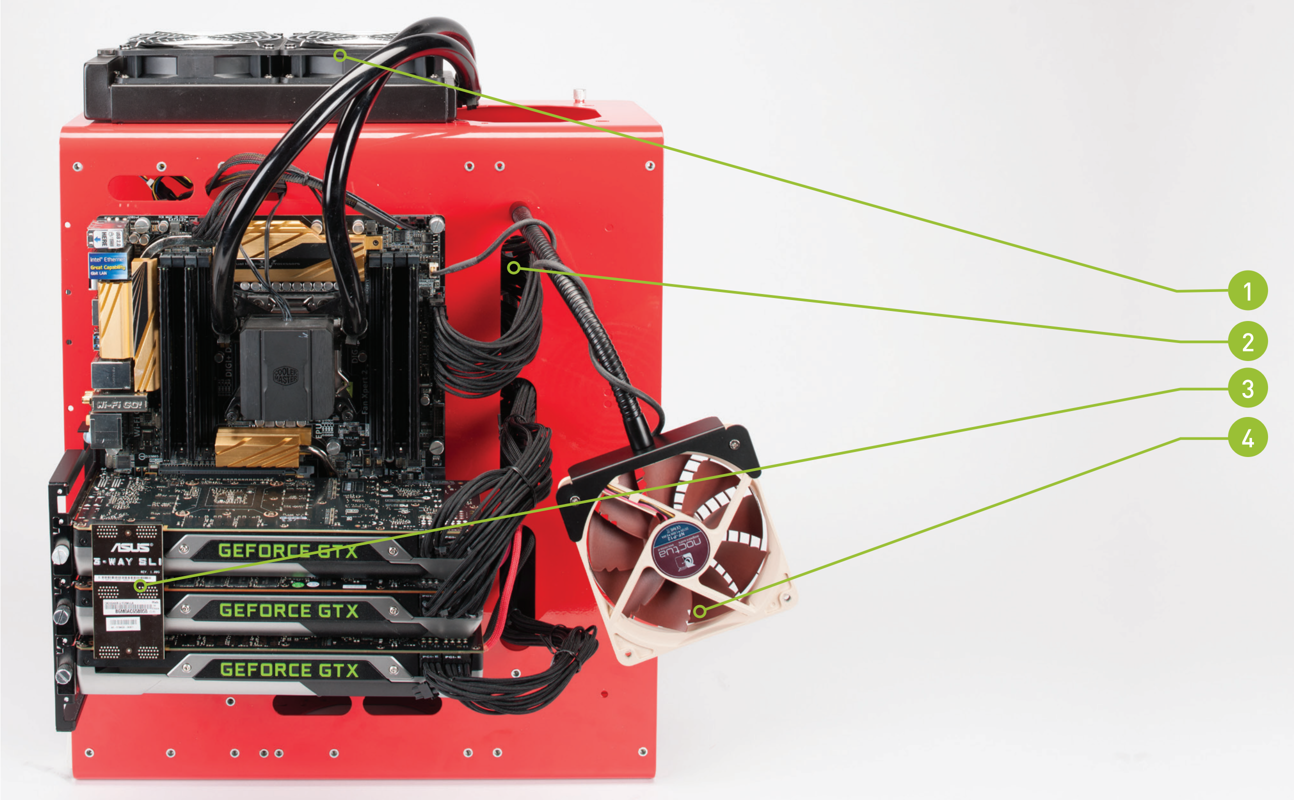
**THIS BENCH HAS** a black bracket that holds your PCIe cards and can be slid parallel to the motherboard to accommodate different board layouts. It will take up to four two-slot cards, and DimasTech sells a longer 10-slot bracket on its website for workstation boards. We had to use the provided aluminum thumbscrews to secure the cards, since all of the screws we had in The Lab were either too coarsely threaded or not the right diameter, which is unusual. Installing cards is easy, because your view of the board slot is not blocked by a case. The video cards will end up sandwiched right next to each other, though, so you'll need a tool to release the slot-locking mechanism on two of them (we used a PCI slot cover). The upper two cards can get quite toasty, so we moved the bench's built-in flexible fan arm right in front of their rear intake area, and we told the motherboard to max out its RPM. We saw an immediate FPS boost in our tests, because by default these cards will throttle once they get to about 83 C.

GEFORCE GTX
GEFORCE GTX
GEFORCE GTX

## 6

## COOL UNDER PRESSURE

**SINCE THE GLACER** 240L cooler has integrated tubing that's relatively short, the orientation pictured was our only option. We could have put the fans on the other side of the radiator, but since performance was already superb, we decided we liked the looked of them with the grills on top. To mount the radiator, we used the bundled screws, which became the right length when we added some rubber gaskets, also included. The radiator actually doesn't give off much heat, even when the CPU is overclocked and firing on all cylinders, so we didn't have to worry about the nearby power supply fan pulling in a lot of hot intake. In fact, the CPU never crossed 65C in all of our benchmarks, even when overclocked to 4.5GHz. We even threw Prime95 at it, and it didn't break a sweat. Temperatures are also affected by ambient temperatures, though. With our open-air layout, heat coming out of the GPUs doesn't get anywhere near the radiator, and The Lab's air conditioning helps keep temperatures low, so it's pretty much an ideal environment, short of being installed in a refrigerator. Your mileage may vary.



**1. Unlike conventional sealed water coolers, the Glacer 240L's tubes are actually detachable and use G1/4 fittings. So, you can add GPU water-cooling or even replace the radiator.**

**2. The cable cutouts to the right of the motherboard are set farther away because the bench is designed to accommodate big EATX boards, too.**

**3. Most motherboards at this tier come with the three-way SLI bridge necessary to link these cards to each other. We found some listed on Amazon in the $10 range.**

**4. The articulated fan bracket holds a 120mm fan and bends enough to be able to reach every part of the motherboard—we mostly pointed it at our GPUs.**

# A GOLDEN TRIANGLE

**DESPITE OUR** penchant for extreme performance, we rarely build triple-GPU systems, so we weren't sure how well they'd handle 4K, but we figured they'd kick ass. Thankfully, they handled UHD quite well. So well, in fact, that we also tested the system with "only" two GTX 780s and still got respectable gaming performance. For example, with two cards, the Bioshock Infinite benchmark reported an average of a little over 60 FPS on its highest settings. In Tomb Raider, we disabled anti-aliasing and TressFX, maxing out all the other settings, and we still averaged 62 FPS. We benchmarked the opening sequence of Assassin's Creed 4 with AA and PhysX disabled and everything else maxed out, and we averaged 47 FPS. The Metro: Last Light benchmark, however, averaged 25FPS on max settings, even with PhysX disabled.

With the third card enabled, Tomb Raider averaged nearly 100 FPS, and Assassin's Creed bumped up to 60 FPS. We're not benchmarking UHD with anti-aliasing, but 3840x2160 is so extreme that it's difficult to notice any aliasing unless you compare screenshots side by side.

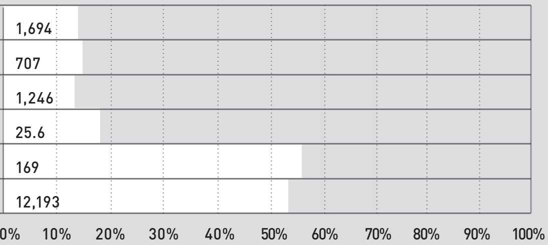
Unfortunately, we had trouble getting Hitman: Absolution and Metro: Last Light to recognize the third card. This issue is not unheard of, and made us think: If you stick with two GPUs, you no longer need the PCI Express bandwidth of expensive LGA 2011 CPUs, or their equally expensive motherboards, or a huge power supply. That potentially cuts the cost of this system in half, from around $4200 to roughly $2100. You could also save money by going with, say, a Core i7-4930K instead, and a less expensive LGA 2011 motherboard and a smaller SSD. But it's still a pretty steep climb in price when going from two cards to three.

The test bench itself feels sturdy and looks sweet, but we wish that it accepted standard computer-type screws, and that it came with a 2.5-inch drive bay or could at least fit a standard 3.5-to-2.5 adapter. We'd also recommend getting a second articulating fan arm if you're liquid-cooling, so that one could provide airflow to the voltage regulators around the CPU, and the other could blow directly on your video cards. With the fan aimed at our cards, we instantly gained another 10 FPS in the Tomb Raider benchmark.

The Seagate 600 SSD was nice and speedy, although unzipping compressed files seemed to take longer than usual. The X79 Deluxe motherboard gave us no trouble, and the bundled "Asus AI Suite III" software has lots of fine-grained options for performance tuning and monitoring, and it looks nice. Overall, this build was not only successful but educational, too.

## BENCHMARKS

| | ZERO-POINT | |
|---|---|---|
| Premiere Pro CS6 (sec) | 2,000 | 1,694 |
| Stitch.Efx 2.0 (sec) | 831 | 707 |
| ProShow Producer 5.0 (sec) | 1,446 | 1,246 |
| x264 HD 5.0 (fps) | 21.1 | 25.6 |
| Batman: Arkham City (fps) | 76 | 169 |
| 3DMark11 Extreme | 5,847 | 12,193 |



The zero-point machine compared here consists of a 3.2GHz Core i7-3930K and 16GB of Corsair DDR3/1600 on an Asus P9X79 Deluxe motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.

# REVIEWS

TESTED. REVIEWED. VERDICTIZED.

**MAINGEAR PULSE 17**
**PAGE 76**

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You can customize the backlit LED keyboard's colors to your heart's content.

# Maingear Pulse 17

## A large, light gaming laptop marred by several flaws

**LIKE THE** iBuypower Battalion laptop we reviewed in the March issue, Maingear's Pulse 17 is aimed at enthusiasts who want a large gaming laptop but don't want to kill themselves lugging it around.

The 17.3-inch Pulse 17 fits the bill in screen real estate, and at 0.8-inches thick and 6 pounds, it's in line with the thinnest laptops while maintaining a manageable weight. However, what it saves you in weight, it eats up in footprint, with a 16.5-inch by 11.2-inch spot on your desk. It's large enough that it won't fit in most normal-sized laptop backpacks.

Though it uses the same chassis as iBuypower's Battalion, Maingear says that unlike that machine, its Pulse 17 gives customers the option to opt for a wireless AC network card (for an additional $50), the widest array of SSD options (up to two MSATA 256GB SSDs in RAID 0), and a custom lid paint job. You can choose among a wide variety of colors (we opted for the "Alpine White" coat for a clean look), and while that's certainly appreciated, the paint job is a little rough around the edges of the Main Gear logo on the lid. That cuts two ways, though; a decal would be cleaner, but then it's a decal, not a custom paint job.

Even though that's certainly a small gripe, the build quality in general seemed a little subpar. The chassis allows quite a bit of flex, making it impossible to pick up the notebook without hearing it creak. In addition, one of its rubber feet fell off, which is annoying and further indication of a substandard build. The notebook's keyboard is similarly lackluster; its keys lack a firm tactile response. We also had an issue with the space bar intermittently failing to register presses. Unfortunately, its ELAN trackpad was unresponsive when it came to two-finger scrolling. Even worse is the gesture used for two-finger scrolling, which is counter to how smartphones maneuver, with no way to change it in settings. We wish we could say that the panel and speakers made up for these shortcomings, but both the TN panel and the speakers were meh.

Thankfully, the laptop's performance is very respectable, especially when you consider its form factor. Inside, you'll find a quad-core 2.4GHz Core i7-4700HQ CPU, 16GB of DDR3/1600, and the most popular GPU for ultra-thin gaming laptops today: a GeForce GTX 765M.

While the Pulse 17's graphics card score tied our Alienware 14 zero-point laptop (which also uses a GeForce GTX765M), the Pulse 17 was able to outperform it by 5 percent in both our Metro: Last Light and BioShock Infinite benchmarks.

What this amounts to in real-world terms is average frame rates in the high 50s playing BioShock Infinite on "medium" settings. It wasn't quite as impressive CPU-side, though, falling in line with Alienware's very similar Core i7-4700MQ chip in single-threaded tasks, but faltering 6 percent in our multithreaded x264 test. It also wasn't quite as energy-efficient as the Alienware 14, but its 6-cell battery did last around 3.5 hours in our video rundown test, which is actually longer than the majority of gaming laptops we've reviewed, especially compared to iBuypower's similarly spec'd Battalion notebook, which couldn't even make it to 2.5 hours.

Where the iBuypower laptop really has the advantage over the Maingear, however, is in price. At $2,400, the Pulse 17 costs a whopping $540 more with very similar specs. Yowza! The added expense likely comes down to the custom paint job that Maingear offers, and the company's two-year warranty program versus the one-year warranty that iBuypower provides. If you don't care about those added features, but are still interested in the laptop, we recommend going with iBuypower's product. **–JIMMY THANG**

**VERDICT** 7

**Maingear Pulse 17**

**PULSE** Good battery life; thin and relatively light; never ran hot or loud.

**FLAT LINE** Overpriced; build quality and paint job need work; shoddy keyboard and trackpad.

$2,400, www.maingear.com

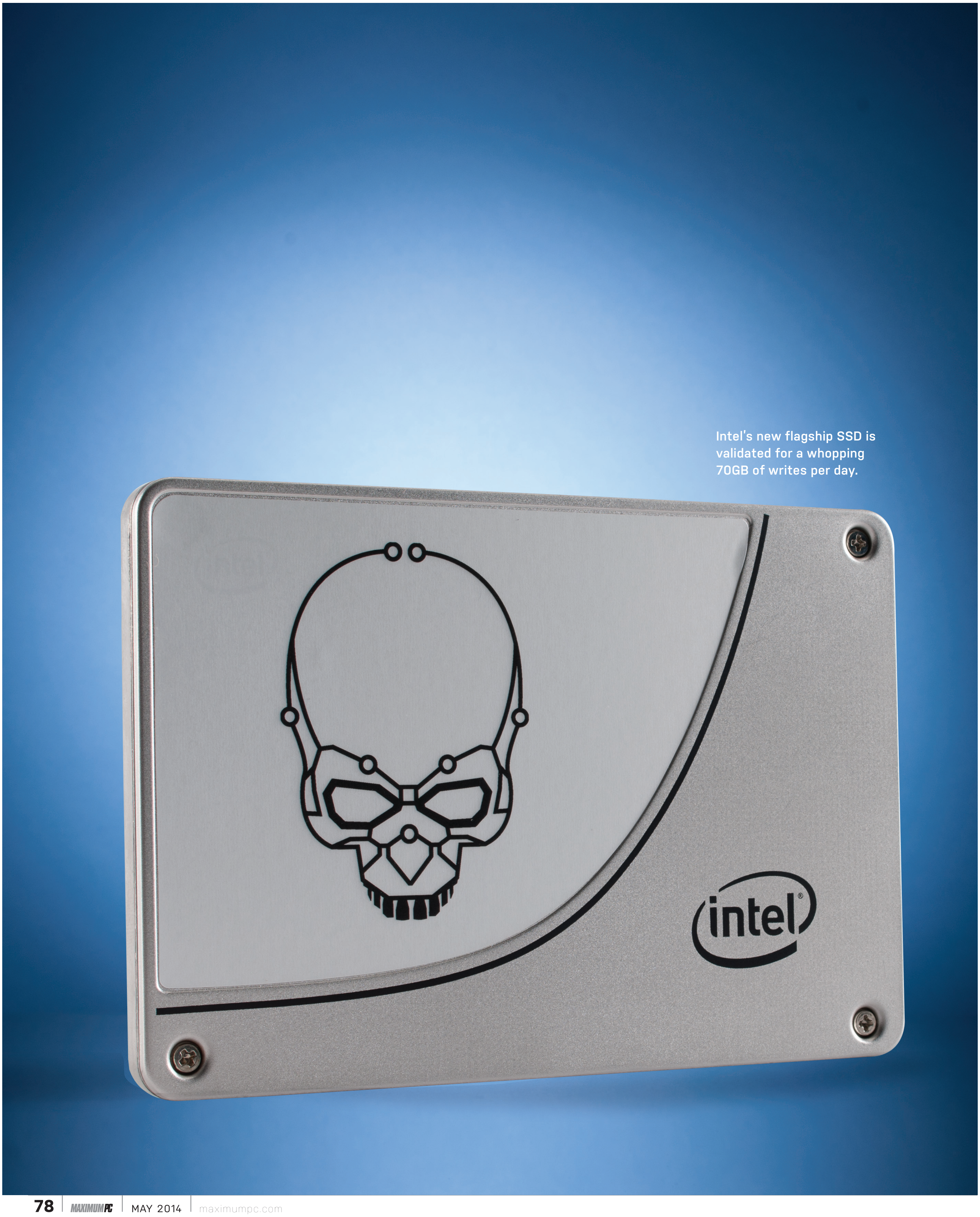
### BENCHMARKS

| | ZERO-POINT | |
|---|---|---|
| **Stitch.Efx 2.0 (sec)** | 962 | 983 (-2.1%) |
| **Proshow Producer 5 (sec)** | 1,629 | 1,622 |
| **x264 HD 5.01 (fps)** | 13.5 | 12.6 (-6.7%) |
| **Bioshock Infinite (fps)** | 36.1 | 38.1 |
| **Metro Last Light (fps)** | 30.4 | 32 |
| **3DMark 11 Perf** | 4,170 | 4,170 (0%) |
| **Battery Life (min)** | 234 | 205 (-12.4%) |
| | | 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% |

Our zero-point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5,400rpm HDD, a GeForce GTX 765M, and 64-bit Windows 7 Home Premium. BioShock Infinite tested at 1920x1080 at Ultra DX11 settings; Metro Last Light tested at 1920x1080 at DX11 medium-quality settings with PhysX disabled.

### SPECIFICATIONS

| | |
|---|---|
| **CPU** | 2.4GHz Intel Core i7-4700HQ |
| **RAM** | 16GB DDR3/1600 |
| **Chipset** | Intel HM87 |
| **GPU** | Nvidia GeForce GTX 765M |
| **Display** | 17.3-inch, 1920x1080 TN (matte) |
| **Storage** | 1TB HDD (5,400rpm), 256GB SSD |
| **Connectivity** | Ethernet, HDMI, 2x Mini DisplayPort, media card reader, 4x USB 3.0, mic input, headphone input, mic/headphone input, 2MP webcam, Bluetooth 4.0, 802.11n, DVD burner (external) |



Intel's new flagship SSD is validated for a whopping 70GB of writes per day.

# Intel 730 Series SSD 480GB

## An overclocked enterprise SSD, priced accordingly

**INTEL HAS LARGELY** been absent from the high-end SSD market for many years, which has been a real head-scratcher, considering the original X-25M's dominance back in 2009. That all changes this month with the release of its all-new 730 series SSD. It springs from the loins of its data center SSDs, which use validated NAND and Intel's enterprise-level controller technology. To emphasize this heritage, Intel isn't bragging about the drive's overall speed, but instead notes the drive is rated to handle up to 70GB of writes per day, which is higher than any other SSD on the market by a huge margin. It features capacitors to protect data being written in case of a power outage, which is an unusual but not unprecedented feature on a consumer SSD. Intel also backs the drive with a five-year warranty

To create the 730 Series, Intel has basically taken the NAND flash and controller from its data center–oriented S3700 SSD and bumped up the clock and interface speeds. If you recall the “SSD overclocking” demo Intel held at Pax last year, this is the result, though Intel decided against letting consumers overclock the drive. Instead, it did the overclocking at the factory so that the drives could be validated at those speeds. To drive home the point that this is an SSD made for enthusiasts, Intel has even adorned it with a sweet-looking Skulltrail badge.

The drive is a 7mm unit, so it will fit inside an ultrabook, but is available only in 240GB and 480GB capacities. It's odd that it's not available in 750GB or higher capacities, but our guess is Intel is afraid of the sky-high sticker price that such a drive would require; the two capacities it's offering are priced very high at $250 and $490, respectively. The drive features Intel's 20nm MLC NAND and its own third-generation controller. It's ditched SandForce, along with all the other SSD makers in the business. One interesting note is that since this is an enterprise drive, it essentially doesn't have a “low-power state,” so it's not intended for mobile usage. Also, it consumes 5W under load, which is double the consumption of even a 7,200rpm mobile hard drive.

When we strapped the 730 Series drive to our test bench, we saw results that were a bit slower overall than we expected. It topped the charts in AS SSD, which measures read and write speeds of incompressible data, but the Intel drive was only a smidge faster than most, and not by enough to make it stand out, as they are all very fast. It was a bit slower than average in straight-line sequential read speeds, topping out at 468MB/s for reads and 491MB/s for writes. While this is still plenty fast, it's a bit short of the 550MB/s Intel claims the drive is capable of, which is totally saturating the SATA 6Gb/s interface.

It was also oddly slow in the ATTO benchmark, which has a queue depth of four and is a “best case scenario” for most drives. It scored just 373MB/s for 64KB-read speeds, compared to 524MB/s for the Samsung 840 Pro. We ran the test several times to verify, so it's not an aberration. It placed mid-pack in PCMark Vantage, but was slower than its competition in our real-world Sony Vegas test, where we write a 20GB uncompressed AVI file to the drive.

Overall, this drive is a bit of a conundrum. We have no doubt it's reliable, as Intel has always been strong in that regard and this drive is full of safety-oriented features. But is it more reliable than a Samsung 840 Pro for the average consumer? We doubt it, and therefore the drive's extra-high price tag doesn't make much sense. If Intel realizes it's no longer the only game in town and adjusts the price a bit, it'll be a much more competitive drive, but as it stands, we must give it a so-so verdict of 8. **–JOSH NOREM**

**BENCHMARKS**

| | Intel 730 Series | Samsung 840 Pro | Sandisk Extreme II | OCZ Vector | Corsair Neutron GTX |
|---|---|---|---|---|---|
| **Controller** | Intel 3rd Gen. | MDX | Marvell 88SS9187 | Barefoot 3 | LAMD |
| **Capacity** | 480GB | 512GB | 480GB | 512GB | 480GB |
| **CrystalDiskMark** | | | | | |
| **Avg. Sustained Read (MB/s)** | 468 | **534** | 521 | 502 | 441 |
| **Avg. Sustained Write (MB/s)** | 491 | **514** | 484 | 499 | 478 |
| **AS SSD - Compressed Data** | | | | | |
| **Avg. Sustained Read (MB/s)** | **515** | 513 | 508 | 507 | 507 |
| **Avg. Sustained Write (MB/s)** | 471 | **495** | 473 | 494 | 475 |
| **ATTO** | | | | | |
| **64KB File Read (MB/s)** | 373 | 524 | **525** | 511 | 345 |
| **64KB File Write (MB/s, 4QD)** | 468 | **497** | 493 | 480 | 485 |
| **Iometer** | | | | | |
| **4KB Random Write 32QD (IOPS)** | 78,242 | 82,297 | 42,699 | 83,531 | **85,375** |
| **PCMark Vantage x64** | 49,969 | 75,205 | 38,093 | **75,863** | 67,426 |
| **Sony Vegas Pro 9 Write (sec)** | 442 | 294 | **275** | 314 | 286 |

Best scores are bolded. All tests conducted on our hard-drive test bench, which consists of a Gigabyte Z77X-UP4 motherboard, 3.2GHz Core i5-3470 CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.

**VERDICT** 8

**Intel 730 Series SSD 480GB**

➕ **SKULLS** Five-year warranty; 70GB write/day; fast enough; Intel reliability.

➖ **TRIBAL MARKS** Too expensive; not the fastest; consumes a lot of power.

$490, www.intel.com

# Dell UltraSharp UP2414Q

## The 4K monitor you've been waiting for?

**CALL IT 4K.** Call it UltraHD. Either way, massive pixel counts are the next big thing. This year's festival of rampant consumerism at CES in Las Vegas is a case in point. Inevitably, a ton of 4K HDTVs filled the field of view in every direction, but the show also included several 4K and UHD laptops. Meanwhile, phones with full 1080p grids are becoming commonplace. Likewise, tablets with panels over 1080p, including Google's 2560x1600-pixel Nexus 10, are now almost routine.

But what of the PC? Sadly, it's been a bit of a 4K laggard to date. So far, we've only reviewed a single 4K PC monitor, the Asus PQ321. It's absolutely, positively gorgeous, but also punitively priced at around $3,000. So expensive, in other words, that it's pretty much irrelevant to most PC lovers.

That's actually rather ironic, because of all the devices out there, the PC is nearest to ready-and-able to make the most of 4K resolutions right now. 4K HDTVs, quite frankly, are a gimmick; there's simply no content to watch on them yet. Super-high-resolution tablets and phones are marginal, too. But not PCs. Ramp up the res and you can immediately enjoy the boost in desktop elbow room, although you may run into scaling and DPI problems with Windows (more on that a bit later). Applications in the video and photo editing spheres certainly benefit from more pixels. Then there's gaming, which is the biggie for us, though the argument here is more finely balanced.

In theory, you can run pretty much any game at full 4K. Most will offer the option to render at the maximum resolution of your graphics subsystem. And render they will. The only snag involves achieving that at playable frame rates. As we explained in our Asus PQ321 review, 4K/UHD is essentially four times the resolution of a 1080p pixel grid, so that's four times the workload for your GPU to cope with. Cripes. So, it's into this broader context that we introduce our second-ever 4K PC monitor review.

The specimen in question this time is Dell's new UltraSharp UP2414Q. It sports the same 3840x2160 resolution as the groundbreaking Asus PQ321, but there are two significant differences. The first of these is price; the new Dell can be had for slightly under $1,300—less than half the cost of the Asus. That's still not exactly cheap for a monitor, but it's much, much more accessible.

The second major change-up involves panel proportions. The Dell spans a mere 24 inches—so that's $1,300 for a 24-inch monitor. Yikes. Of course, you could argue that it's resolution and not size that determines desktop real estate, and you'd be right, but some people will still balk at the very notion of paying so much for a panel size that can be had for little more than $120 these days.

The UP2414Q's general metrics are your typical IPS fare, with 178-degree viewing angles for both the horizontal and vertical planes. Likewise, the claimed static contrast of 1,000:1 is very much par for the course, and the UP2414Q's 8ms quoted response is the same as other cutting-edge IPS panels.

Of course, all of that means there are some superior options available by some measures. IPS technology is all the rage, but in truth, TN tech is better for pixel response and VA panels offer far superior contrast. Overall, IPS is still the best compromise—just don't fall into the trap of assuming it's universally superior. It ain't quite that simple.

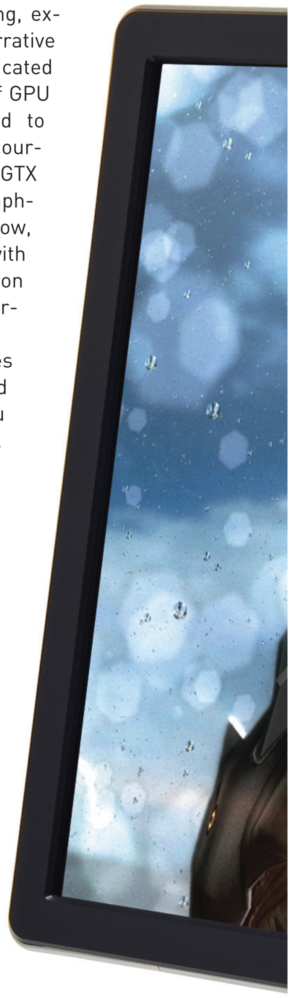
Elsewhere, there's an LED backlight and brightness rated at 350cd/m2, and a super-fine pixel density of 185PPI. As for inputs, the UP2414Q has one HDMI, one DisplayPort, and one Mini DisplayPort. Thanks to the super-high resolution, it's only the DisplayPort that offers full native operation. The lone HDMI port is limited to HDMI 1.4, and you need HDMI 2.0 for 4K at 60Hz. Finally, there's a fully adjustable chassis, complete with tilt, rotate, swivel, and height tweakability.

What is it actually like to look at? Utterly stunning, is the first impression. Even the epic Asus can't match the crispness and sharpness that you get from cramming all those pixels into such a relatively small panel.

As with super-high DPI phones and tablets, you almost don't feel like you're looking at an active display at all. You essentially can't see the individual pixels—they're simply too small—which gives the UP2414Q a wonderfully seamless feel.

The colors are exquisite, too, though admittedly, no more so than many other high-end IPS screens; they all look spectacular these days. The same goes for the results in our objective image quality test. Gradient rendering, viewing angles, white and black scales—they're all absolutely immaculate and super sexy—again, just like other pricey IPS screens.

Then, there's actually using this 4K beauty for multimedia entertainments. Not that there's much 4K video content to watch, but what there is, by the lords of science, is gorgeous! It more or less ruins standard 1080p HD content for you. Once you've seen 4K, there's almost no going back.



The same goes for gaming, except this time round, the narrative is a little bit more complicated and depends on what kind of GPU you're packing. We decided to take the UP2414Q for a spin courtesy of an Nvidia GeForce GTX 780 Ti, the fastest single graphics card you can buy right now, and it can only just cope with that colossal native resolution at full detail gaming in moderately demanding titles.

Speaking of technologies that aren't ready for 4K and super-high DPI displays, you can add Windows to the list. Even the latest 8.1 build of Windows does a poor job of scaling, and believe us, you really will want to enable some kind of scaling. If you try running the UP2414Q at native resolution, with standard Windows DPI and standard font size settings, everything on the screen looks preposterously tiny. It just isn't usable. Even If you fiddle around with the fonts and text scaling, you'll still hit problems. Sure, you can achieve something legible, and we'd even concede that many core elements of the Windows 8.1 desktop interface, including Windows Explorer, scale nicely and look superb. Unfortunately, most third-party apps look, if you'll pardon the colloquialism, utterly ass. What you get is a blurred, blown-up bitmap that makes everything look soft and fuzzy. The same goes for nearly all web pages and the Steam interface. The harsh truth is that much of the computing world isn't ready for high-DPI displays, and that becomes all too apparent as soon as you fire up the UP2414Q.

Windows 8.1's Modern UI is properly scalable, and looks crisp and clean for the most part, but it's probably not the bit of Windows most people will be planning to use predominantly with a monitor that's not touch-enabled.

All of which makes this 24-inch 4K monitor a tricky proposition. It looks absolutely fantastic, but at this stage, it's probably of more interest to content-creation professionals than PC performance and gaming enthusiasts. Instead, it could well be a TN panel that is larger and half the price that makes ultra-HD resolutions a practical, affordable prospect for gaming and other desktop PC applications. **–JEREMY LAIRD**

**VERDICT 9**

**Dell UltraSharp UP2414Q**

➕ **KATANA** Dense PPI; almost affordable.

➖ **DAGGER** OS support poor for high PPI.

$1,300, www.dell.com

### SPECIFICATIONS

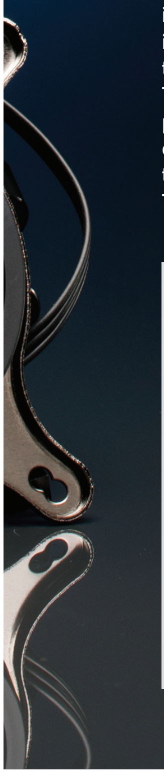
| | |
|---|---|
| **Panel Size** | 23.8 |
| **Panel Type** | IPS |
| **Resolution** | 3840x2160 |
| **Contrast** | 1,000:1 |
| **Pixel Response** | 8ms |
| **Ports** | HDMI, DisplayPort, Mini DisplayPort |

Dell's UP2414Q is beautiful, but slightly ahead of its time.

Since this pump does not offer variable speeds, it can be plugged directly into the power supply for maximum effectiveness.

# Corsair Hydro H105

## The H75's big brother is not too shabby



**OVER THE PAST** couple of years or so, we gearheads have transitioned from membrane keyboards to mechanical ones; from mechanical hard drives to SSDs; and from air-cooling our CPUs to using closed liquid loops. All favorable moves, though the latter group suffers from a lack of variety. You can get radiators in 120mm, 240mm, and 280mm sizes, but they're almost all painted plain black with black tubing, although some include the small style concession of a glowing logo on the pump housing. Part of this has to do with just a handful of companies designing coolers for a large number of brands. This plainness may be a drag in a tricked-out rig, but in the case of the Corsair H105, we've discovered that a lack of fanciness can be an advantage.

Corsair's H105 radiator is thicker than usual (38mm instead of 27mm), and there's a silver ring on the top of the pump that can be switched out for a red or blue one. But it's not reinventing any wheels. Its tubing isn't thick, and its pump isn't very large. But you'll notice how easily it installs in your system. There's just one basic fan cable for the pump, which you can plug into any header on the motherboard, or directly into the power supply with a Molex adapter. The pump has two speeds: on and off. The fans use PWM control, so they'll spin up and down smoothly, according to temperature readings. Just attach them to the bundled standard splitter cable, then connect that to the motherboard's CPU fan header. And there's no software this time; you just use your motherboard's fan controls instead.

Our test bed's Rampage IV Extreme motherboard has Windows-based software called "Fan Xpert" that intelligently controls fan speeds. We ran our torture test with the H105's fans set to "Quiet" in Fan Xpert, and got a pretty respectable 70 Celsius. When pushed to "Turbo" mode, the fans spun up to about 2,000rpm and lowered CPU temps to 65C. These aren't the lowest temperatures we've seen, but they're still pretty respectable, and the H105's noise levels were surprisingly good. However, we couldn't get a clear picture of how much the thickness of the radiator compensated for the modest diameter of the tubing and size of the pump. Those two properties seem to give the Cooler Master Glacer 240L and Nepton 280L an edge. But at press time, the H105 cost less at most stores than the Glacer (we suspect partly because the Glacer is an expandable system), and the Nepton has a 280mm cooler that doesn't fit in a lot of cases.

If you want a liquid-cooling system with a 240mm radiator, and you don't care about expandability, then the ease of installation, ease of use, and manageable noise levels of the H105 make it hard to beat for the price. And like all Corsair liquid coolers, it gets a five-year warranty, whereas the competition usually gives you two or three years of coverage. On the other hand, the radiator's extra 11mm of thickness makes it too large for certain cases. Corsair says that the cooler is compatible with "the vast majority" of chassis, but its list leaves off a number of seemingly workable cases of its own, such as the Carbide 500R and the Graphite 600T. If you can spend more money, there are slightly better coolers out there, but the H105 is a well-rounded package. **–TOM MCNAMARA**

**VERDICT**
**9**

**Corsair Hydro H105**

➕ **ROBOCOP** Smooth installation; uncomplicated fan control; quieter than average.

➖ **OMNI CONSUMER PRODUCTS** Not quite top-tier performance; radiator size can be an issue.

$120, www.corsair.com

### BENCHMARKS

| | Corsair Hydro H105 Quiet / Performance Mode | Cooler Master Nepton 280L Quiet / Performance Mode | Cooler Master Glacer 240L Quiet / Performance Mode | Cooler Master 212 Evo Quiet / Performance Mode |
|---|---|---|---|---|
| **Ambient Air** | 22.9 / 22.8 | 22.1 / 22.4 | 22.7 / 23.2 | 20.5 / 20.3 |
| **Idle Temperature** | 34.2 / 29.2 | 33.2 / 30 | 33.7 / 29.5 | 35.5 / 30.5 |
| **Load Temperature** | 69.2 / 65 | 64.5 / 63.3 | 67.2 / 62.8 | 70 / 67.3 |
| **Load - Ambient** | 46.3 / 42.2 | **42.4** / 40.9 | 44.5 / **39.6** | 49.5 / 47 |
| **Street Price** | $120 | $140 | $140 | $35 |

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard, in a Corsair 900D with stock fans set to Standard.

### SPECIFICATIONS

| | |
|---|---|
| **Radiator Dimensions (H x D x W)** | 1.5 x 10.7 x 4.7 inches |
| **Weight** | 2.45 lbs |
| **Stock Fans** | 2x 12cm PWM |
| **Socket Support** | LGA 1150/1155/1156/1366/ 2011; AM2/AM2+/AM3/AM3+/ FM1/FM2/FM2+ |
| **Additional Fan Support** | 2x 12cm |

We were sorely tempted to ding the D54250WYKH a point for its boring, annoying name.

# Intel NUC D54250WYKH

## You can stuff 3TB of storage into this baby

**INTEL'S COOL** Next Unit of Computing (NUC) PCs have one serious limitation compared to say an All-In-One PC: storage. With room for just a single mSATA drive, NUC storage was limited to about 1TB. That's no longer the case, though, thanks to the new NUC D54250WYKH, which accepts 2.5-inch drives in addition to mSATA devices.

Yup, if you enjoy memorizing Intel SKU numbers to impress people at cocktail parties, you'll recognize that the NUC D54250WYKH is just one letter different from sibling, the NUC D54250WYK, which we reviewed in our March Ultra Compact SFF roundup. Besides the extra H, the obvious difference is the increased height of this NUC. The unit is about half an inch taller but retains the standard 4.5-inch by 4.5-inch width and depth of all NUCs. The increased depth is to accommodate the installation of a 2.5-inch SATA drive. You may scoff at the notion of a 2.5-inch tray having an impact on a system's storage, but the alternative is the single mSATA slot, which is far more limited. There's enough room inside to stuff a standard 9.5mm SSD or HDD, and while you won't get a 4TB hard drive inside, you can get Seagate's 2TB 9mm Spinpoint M9T to fit. Even better, you can use the M9T for bulk storage and still run your OS from an mSATA drive. The 2.5-inch tray also gives budget-minded builders the option to run much cheaper 2.5-inch SSDs instead of pricey mSATA drives.

Inside, you'll find an mSATA slot, a mini PCIe slot for wireless, and a pair of low-voltage DDR3 SO-DIMM slots. The NUC supports RAM speeds up to DDR3/1600, and Intel means it. We tried to push it further with a pair of low-voltage 8GB G.Skill DDR3/1866, but got occasional bluescreens, so it looks like this NUC is stuck at DDR3/1600. That's unfortunate, because a little more memory bandwidth would certainly help the graphics performance.

Speaking of performance, we feel pretty good scoring the performance of this NUC, now that we've had half a dozen of these pint-sized PCs through the lab. Our zero-point is the older Ivy Bridge–based NUC. That unit runs a 1.8GHz Core i3-3217U with HD4000 graphics, so it's a dual-core part with Hyper-Threading but no Turbo Boost. The new "fat NUC," as we call it, easily slams the older Ivy Bridge unit by a significant margin, thanks to its Turbo Boost and newer Haswell cores. Interestingly, we expected the performance of this NUC to be the same as the NUC D54250WYK we reviewed last month since both units use the same motherboard and CPU. All Intel really did was add the 2.5-inch drive tray and increase the size of the unit, but otherwise they are the same. While both perform about the same in most of the benchmarks, the taller NUC had the edge in gaming. Why? We suspect driver updates after we originally ran our tests. In practical gaming, you shouldn't have high expectations. The 10-year-old Counter Strike: Source is very playable at greater than 60 fps at 1080p, and Counter Strike: GO ran well, too. We also ran Minecraft at about 40–50 fps (although the game can scale up with high-res textures). In CPU-intensive chores, though, the Fat NUC fares well. It's certainly not in the same league as Gigabyte's Kick Ass Brix Pro, but for most things people will do with a NUC, it's more than enough and actually quieter than the Brix Pro, too. At the end of the day, it is still just a dual-core part.

We like this new NUC as much as we liked the Intel NUC D54250WYK, being as they're, well, almost the same. There is a cost premium for the thicker unit, but for someone who intends to store a lot of files or use it as an HTPC box, it's well worth it.

**–GORDON MAH UNG**

### BENCHMARKS

| | Intel NUC D54250WYKH | Intel NUC DC3217IYE | Intel NUC D54250WYK * | Gigabyte Brix Pro GB-BXi7-4770R * |
|---|---|---|---|---|
| **CPU** | 1.3GHz Core i5-4250U | 1.8GHz Core i3-3217U | 1.3GHz Core i5-4250U | 3.2GHz Core i7-4770R |
| **Graphics** | HD5000 | HD4000 | HD5000 | Iris Pro 5200 |
| **Stitch.EFx (sec)** | **1,764** | 2,453 | 1,747 | 867 |
| **ProShow Producer (sec)** | **2,562** | 3,729 | 2,567 | 1,410 |
| **3DMark Cloud Gate** | **4,750** | 3,409 | 3,958 | 10,406 |
| **3DMark Ice Storm** | **47,400** | 35,969 | 32,157 | 68,195 |
| **Counter Strike: Source (fps)** | **63.3** | 52.4 | 63.23 | 149.43 |
| **Google Octane 2.0** | **17,782** | 10,643 | 17,832 | 26,893 |
| **Power Consumption Idle (watts)** | 5 | 8 | 5 | 8 |
| **Power Consumption Prime95+Furmark (watts)** | 23 | 35 | 24 | 87 |
| **Power Consumption YouTube 1080p (watts)** | 14 | 14.5 | 19 | 20 |
| **Street Price** | $460 | $265 | $380 | $650 |

Best scores are bolded. The Intel NUC D54250WYK and Gigabyte Brix Pro GB-BXi7-4770R are included for reference. We tested with 8GB of DDR3/1600 and Windows 8.1 Enterprise. *For reference only.

**VERDICT 8**

**Intel NUC D54250WYKH**

➕ **HOBBITS** Fairly quiet under load.

➖ **EWOKS** Needs more cowbell and graphics performance.

$460; www.intel.com

### SPECIFICATIONS

| | |
|---|---|
| **CPU** | 1.3GHz Core i5-4250U |
| **Graphics** | HD5000 |
| **Ports** | Mini HDMI 1.4a, DisplayPort 1.2, 4x USB 3.0, gigabit Ethernet, analog audio out, IrDA, Kensington lock port |
| **Storage Support** | 2.5-inch SATA, mSATA |

OCZ's new drive has a more subdued, corporate look to it, thanks to a takeover by "the man."

# OCZ Vertex 460 240GB

## Rumors of its death were greatly exaggerated

**THAT LAST TIME WE** heard from OCZ was back before the end of 2013, when the company was in the grips of bankruptcy and nobody was sure what its future held. Fast forward to March 2014, and things are looking rather good for the formerly beleaguered company, much to everyone's surprise. Rather than simply dissolve and fade away like we had feared, the company has been acquired by storage behemoth Toshiba, and is now operating as an independent subsidiary.

The best news is OCZ's NAND-acquisition troubles are seemingly a thing of the past, as Toshiba is one of the world's largest manufacturers of NAND. So, it is no surprise that the first drive we're seeing from the new venture is essentially a reborn Vector drive, only with Toshiba NAND flash. Dubbed the Vertex 460, this "new" drive blends the company's proprietary Barefoot 3 controller found on its high-end Vector drives with Toshiba's 19nm MLC NAND flash, so it's ditching the Micron NAND it used previously. The result is basically a slight watering-down of its Vector 150 drive in order to make it more affordable and consumer-friendly. It also needed to bring its Barefoot 3 controller over to its mainstream line of Vertex-branded drives, so this drive accomplishes that feat, as well.

In many ways, the Vertex 460 is very similar to the company's recent Vector 150 drive, the only difference being the Vector has a five-year warranty and has a higher overall endurance rating to reflect its use of binned NAND flash. The Vertex 460 is no slouch, though, and is rated to handle up to 20GB of NAND writes per day for three years. The drive also utilizes over-provisioning, so 12 percent of the drive is reserved for NAND management by the Barefoot 3 controller. Though you lose some capacity, you gain longer endurance and better performance, so it's a worthwhile trade-off. The Vertex 460 also offers hardware encryption support, which is very uncommon for a mainstream drive, and though we'd never use it, it's nice to have options. Otherwise, its specs are par for the course in that it's a 7mm drive and is available in 120GB, 240GB, and 480GB flavors. It's also bundled with a 3.5-inch bay adapter as well as a copy of Acronis True Image, which is appreciated.

When we strapped the Vertex to our test bench, we saw results that were consistently impressive. In every test, the Vertex 460 was very close to the fastest drives in its class, and in all scenarios it's very close to saturating the SATA bus, so it's not really possible for it to be any faster. It had no problem handling small queue depths of four commands in ATTO, and held its own with a 32 queue depth in Iometer, too. It was a minute slower than the Samsung 840 EVO in our Sony Vegas test, which writes a 20GB uncompressed AVI file to the drive, but also much faster than the Crucial M500 in the same test. Overall, there were no weak points whatsoever in its performance, but it is not faster than the Samsung 840 EVO, and its OCZ Toolbox software utility is extremely rudimentary compared to the Samsung app. Though the Vertex 460 is an overall very solid drive, it doesn't exceed our expectations in any particular category. In other words, it's a great SSD, but not quite Kick Ass.

–JOSH NOREM

### BENCHMARKS

| | OCZ Vertex 460 | Samsung 840 EVO | Crucial M500 | SanDisk Ultra Plus |
|---|---|---|---|---|
| Controller | Barefoot 3 | MEX | Marvell | Marvell |
| Capacity | 240GB | 960GB | 960GB | 240GB |
| Warranty | 3 years | 3 years | 3 years | 3 years |
| CrystalDiskMark | | | | |
| Avg. Sustained Read (MB/s) | 489 | **596** | 481 | 506 |
| Avg. Sustained Write (MB/s) | 488 | **591** | 446 | 442 |
| AS SSD - Compressed Data | | | | |
| Avg. Sustained Read (MB/s) | 503 | **855** | 493 | 488 |
| Avg. Sustained Write (MB/s) | 491 | **1,002** | 439 | 429 |
| ATTO | | | | |
| 64KB File Read (MB/s) | **519** | **519** | 495 | 505 |
| 64KB File Write (MB/s, 4QD) | 479 | **659** | 442 | 429 |
| Iometer | | | | |
| 4KB Random Write 32QD (IOPS) | 65,242 | **88,859** | 83,710 | 24,430 |
| PCMark Vantage x64 | 72,435 | **100,797** | 71,619 | 32,509 |
| Sony Vegas Pro 9 Write (sec) | 323 | **272** | 485 | 290 |

Best scores are bolded. All tests conducted on our storage test bench, which consists of a Gigabyte Z77X-UP4 motherboard, Intel Core i5-3470 3.2GHz CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.

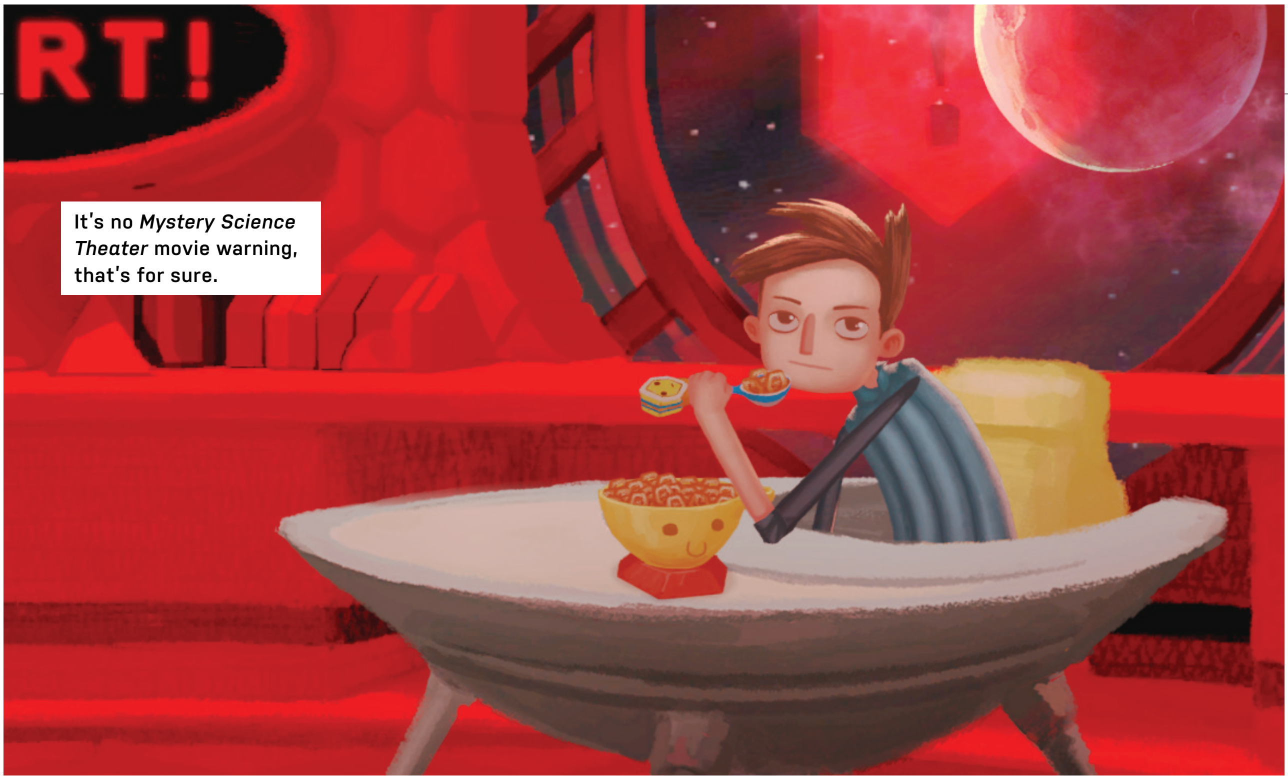
**VERDICT**
**9**

**OCZ Vertex 460 240GB**

+ **SHIBA** Very fast; hardware encryption; well-rounded package.

− **CHIHUAHUA** Software package is basic; not the overall fastest SSD.

$190, www.ocz.com



It's no *Mystery Science Theater* movie warning, that's for sure.

# Broken Age

## Two stories, tons of creativity, yummy ice cream, no grog

**STICK WITH IT.**

That's fair advice for the half of you who will start out Broken Age in a miserable funk instead of a monster-filled fairy tale. At least, that's how we felt when we initially began our trip through Tim Schafer's imaginative title—the first half of a two-part, point-and-click adventure from the industry veteran whose previous credits stand well on their own within the genre: Day of the Tentacle, The Secret of Monkey Island, Full Throttle, et cetera.

The game splits the two protagonists' (seemingly) separate story lines right from the start. We started our journey with the boy, Shay, but found the initial ramp-up to his adventure a bit too convincing.

Without spoiling too much of the plot, Shay is trapped on a spaceship that goes above and beyond to protect him from the harshness of growing up. Shay could not be any more apathetic to the idea of daily life with his "mother," a benevolent, computerized AI of sorts, who washes him, feeds him his daily cereal, and sends him on "adventures" that end in hugs, piles of ice cream, and, most likely, a bout of depression.

The other protagonist of this half-game, Vella, presents a more compelling story line. In this case, you're playing the classic damsel in distress. Rather than being eaten by a giant monster as part of her town's sacrificial ritual to avoid destruction, she decides to go on a one-woman crusade to slay said monster herself.

While Vella's story line is a bit more action-packed—or at least, feels more so as a result of its classic slay-the-dragon-like premise—we actually found ourselves more proud of our experience in Shay's adventure. Our favorite moment involved trying to find a way to "kill" our character, for lack of a better way to say it, in order to see if his daily monotony could be averted somehow. Spoiler: It can.

That's the most challenging example of the game's puzzles that we could come up with, as Broken Age feels perfectly balanced between "breeze on by" and "consult game FAQs" for its overall difficulty. You get just enough quirky items to keep you thinking about what goes where without feeling overwhelmed with options—this isn't a 20-item-inventory, combine-every-gizmo kind of adventure title.

While Broken Age features no hint system, which might frustrate those looking for an extra boost or two in some head-scratching moments, you do have the option to switch between the two separate"story lines at a moment's notice. Think Day of the Tentacle, only, your actions in the two stories don't affect each other—a somewhat curious oversight that we hope developer Double Fine Productions changes up in the game's second half.

There's no real point to spending much time talking about the game's graphics, as you'll fall in love with the beautiful visuals the moment you start adventuring. Kudos to Broken Age's original orchestration as well—it's the bread keeping the delicious presentation together. Sharp writing, endless wit, and excellent characterization (with similarly awesome voice talent) all work in tandem to deliver a welcome arrival to a genre whose blockbuster titles are not always at the forefront of gamers' minds.

You won't forget Broken Age; in fact, we think you'll be clamoring for quite a while to see how chapter one's big cliffhanger ends up. More, Tim Schafer! More!

**–DAVID MURPHY**

**VERDICT**
**8**

**Broken Age**

+ **MOOG SYNTHESIZER** Gorgeous graphics and music; difficulty "feels right;" witty dialogue and lovely voice work; creative story.

− **MOG (FINAL FANTASY)** Two stories feel isolated; Shay story line can take a while to get going; no help system.

$25, www.brokenagegame.com, ESRB: n/a

# LAB NOTES

JIMMY THANG **ONLINE MANAGING EDITOR**

## Breathing New Life into Mobile GPUs

Nvidia claims up to 2x battery life with new Battery Boost feature

**NOTEBOOK SALES**, on the whole, are on the decline. This undeniable fact doesn't foretell death knells for the PC industry, however, because *gaming* notebook sales have never been better. Nvidia is leading the charge in providing the graphics horsepower for these laptops, and the company is about to release some very promising mobile GPUs. First in line is Nvidia's new GeForce GTX 880M, followed by its more budget-friendly 870M, 860M, and 850M parts. While I haven't had the chance to benchmark these GPUs myself, Nvidia tells me that compared to its previous 700M series counterparts, we should see a 15–60 percent boost in performance across the line.

While a performance increase is expected from a GPU update when the model numbers cycle upward by one hundred (500 to 600, 600 to 700, etc.), arguably the most exciting feature about 800M series cards is Nvidia's new Battery Boost technology. The company claims that the new tech has the capability to double battery life, and better yet, that it will do so without any user intervention.

Of course, like most things that sound too good to be true, there are a few costs. As an example, Battery Boost works by slightly reducing graphical settings to optimize power efficiency. Thankfully, Battery Boost will allow you to fine-tune how much graphical detail you're willing to sacrifice for battery life, via a simple slider. In addition, there appears to be a fine level of granularity available, and you'll be able to create presets for different games.

Even though Battery Boost won't be available on older mobile Nvidia cards, including the previous 700-series GPUs, the green team is allowing both its 800M series GPUs and older mobile Kepler parts to support ShadowPlay and GameStream. GameStream lets you stream games from a laptop to an Nvidia Shield, and will also stream games to a laptop using Nvidia's Grid cloud gaming service.

By the time you read this, 800M notebooks should be available, and we will certainly have one in The Lab. Tune in next month for a full report!

NVIDIA
GEFORCE GTX
880M

**The 800M GPUs will support Battery Boost, GameStream, and ShadowPlay.**

### GORDON MAH UNG

**Deputy Editor**

I recently acquired a USB voltage tester, and since then have been busy measuring voltage and amperage draw of various phones and USB devices, as well as wall warts. There's not enough room here for me to detail my findings, but I can say this: If you want faster charging, use a short, high-quality cable.

I can also say that not all USB chargers are the same. Some phones and tablets won't charge at full rate on other makers' chargers. Now, to plug this doo-hickey into front ports on a bunch of machines to see what the actual power output is.

### TOM MCNAMRA

**Associate Editor**

It's been challenging but rewarding to work with a growing number of mini-ITX cases over the past six months or so. Though they've been popular for a while now, initiatives such as SteamOS are bound to boost their popularity even further, and the manufacturers have responded. Corsair has the 250D, which takes a 240mm radiator, and Cooler Master has the Elite 130, which can take a 120mm with push-pull fans. Bigger cases are still cool, but I'm glad that the industry is acknowledging that some people just want a single video card and one or two storage devices. Manufacturers filling this niche is also an indicator that the enthusiast market remains robust.

# First Look:
# Plextor PCIe M6e SSD

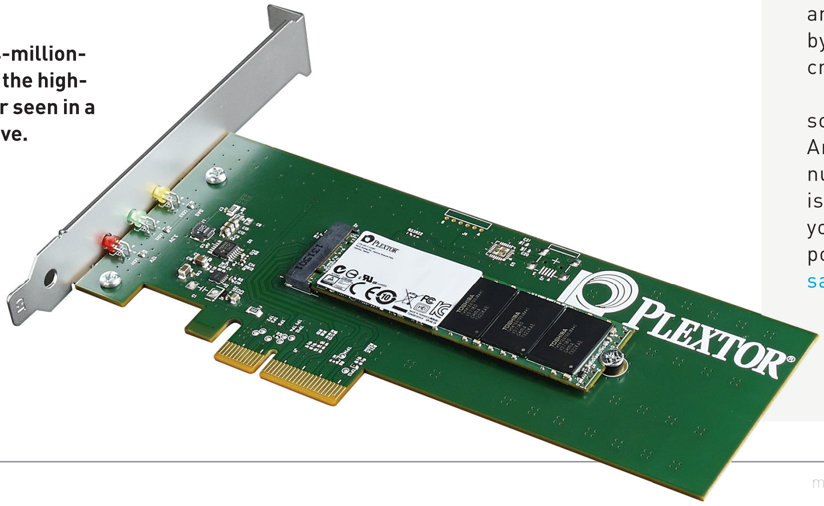
Goodbye SATA 6Gb/s, hello PCI Express (finally!)

**THIS MONTH, WE** got our hands on something we've never seen before, which is rare—a PCIe SSD that is natively PCI Express instead of a SATA drive bolted to an adapter. The drive in question is made by Plextor, uses Toshiba Toggle NAND, and is bolted to a x2 PCI Express 2 card. Unlike the previous PCIe-based SSDs we've tested, this model features an SSD in the new M.2 form factor, which is designed to be the successor to mSATA. It allows higher-capacity drives, as it's available in a variety of sizes, and can feature flash on both sides of the PCB, so it's a much more flexible and scalable design. The variations in size also allow it to be mounted in many different locations inside the belly of an ultrabook. Since it uses PCIe to connect to the host system, it's able to overcome the limitations of the SATA 6Gb/s interface and run a bit faster than current SATA-based SSDs. Plextor says this particular drive can hit sequential read/write speeds of 770/625MB/s and can push over 100,000 iOPS, which is a decent improvement over SATA 6's maximum of around 540MB/s and around 85,000 IOPS.

Since you can't just plug an M.2 drive into your desktop machine, Plextor has mounted the module to a x2 PCIe 2.0 adapter that plugs into your motherboard. We stuck ours into a x16 PCIe 3.0 slot, which, in case you don't know, simply scales back to the number of lanes the card needs. The M6e also includes a decent amount of DRAM cache, with 512MB of DDR3 on the 256GB drive we have in The Lab. The 512GB version of this drive includes a hefty 1GB of DRAM cache, while the 128GB version has just 256MB. For comparison, the Samsung 840 Pro includes 512MB of DDR2/1066 cache. The M6e also includes a five-year warranty and an MTBF of 2.4 million hours. Plextor also says the NAND used for the drive is validated before deployment to reach a "zero error" state. Hardware encryption is supported, and the drives are bootable. While some of the previous PCIe-based storage devices were bootable, many of them were quite picky about their motherboards. You also don't need to install drivers to get the system to recognize the drive—it's detected as an AHCI device on bootup as a storage volume, so you can install Windows to it without any hassles.

The most obvious question for a product like this is simply, "Who would buy this?" Well, if you've got a semi-new motherboard with SATA 6Gb/s ports, then you probably won't see a huge performance increase, but if you're rocking an older board that is saddled with slower SATA 3G/s ports, the M6e will be a substantial upgrade in speed and overall feature-set over an older SSD or (shudder) hard drive.

Though we have only taken a quick look at this drive, our take-away is that it is about the most serious, high-performance drive we've ever seen. Along with having an MTBF rating almost a million hours higher than a Samsung 840 Pro, it also has the highest specs we've seen in a consumer-based SSD. And based on what we've heard from Plextor, its price tag will be actually quite reasonable. The 256GB model we have has an MSRP of $299, though retail pricing will likely be lower. Tune in next month when we take it for a spin around the benchmarks, and deliver our final verdict. **–JN**



**The M6e's 2.4-million-hour MTBF is the highest we've ever seen in a consumer drive.**

**GEEK TESTED & APPROVED**

# SanDisk Ultra Dual USB Drive

If you have a phone or tablet that's running out of storage space, your options are not portable-friendly. USB flash drives need dongles, and swapping SD cards can be a hassle (assuming the device will even take one). Well, SanDisk has introduced the Ultra Dual USB Drive, which is a tiny flash drive with a Micro-USB connector on one end and a regular USB connector on the other. It has a hole for a lanyard, making it difficult to lose (though the hole is so small that high-test fishing line is probably your best option). Capacity tops out at 64GB, despite its mini-ness, and the connectors are protected by sliding sheathes, potentially increasing durability.

It's limited to USB 2.0 speeds, so transfers will be a little pokey. And it's compatible with a limited number of devices (listed on SanDisk's website). But if it works with your device, it's a handy and highly portable gadget. $25 (16GB), www.sandisk.com **–TM**

# LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

## > Tony Stark's Basement
## > Nuking Is Not Enough
## > 我是一個農民的鉛

### Now *That's* Customer Service

Have you heard of a company named "Windows Software Security Solutions" that works for Windows Support? This company is calling people about the removal of "hacker viruses" on peoples computers. They will help you remove them, and then sell you a security software to keep the computer clean of hacker software.

They say that they are working for Windows to support Windows users. Have you heard of this activity by Microsoft?

**—Rich**

**DEPUTY EDITOR GORDON MAH UNG RESPONDS:** Rich, I can tell you that Microsoft will not call you at home to tell you that you have malware and offer to remove it. But I admit, that would be one hell of a service. You have just run into a scam that's been in use for years, in which flimflam artists call misrepresenting themselves to be from "Windows" or Microsoft, and then charge you to remove viruses that aren't even there. These folks typically prey on technophobes. I'd recommend that you either hang up (after saying "Good day to you, sir!") or pranking them like this tech writer did: http://bit.ly/1bHrJyx

### Man vs. Machining

I am a longtime subscriber who has only recently started to take a serious look at building my own system. I see the first step in this is to build a workbench that would make Tony Stark drool in his helmet. I have been impressed and envious of the Dream Machines that *MPC* has produced over the years, but what I really would like to see is your all-out, craziest, coolest, Stark-worthy version of the PC dream garage. What are the coolest products and ideas that you guys can roust up?

**–Chris Hall**

**ASSOCIATE EDITOR TOM MCNAMARA RESPONDS:** It would be tough to top Iron Man, with his genius intellect and deep pockets. But we'd love a table saw, for custom cutting of panels and pipes. An industrial pipe bender would be fun as well, for flashy water-cooled systems. A hydroformer could make some nice sheet metal, too. A CNC router would also allow CAD/CAM-based machining, preferably with a waterjet option. We might not be able to build a computer with that, but maybe we could swing one of Tony's early suit prototypes.

### 在中國最大的電腦

When downloading the March 2010 PDF issue from your archived issues section of the web site, it's in Chinese! Not sure how many (if any) others are that way. I have tried from different machines and email accounts, with the same results. I am in New Hampshire, USA and hope not to have to learn Mandarin to read the magazine.

**—Dick Dubois**

**ONLINE EDITOR MANAGING EDITOR JIMMY THANG RESPONDS:** 我們已經測試了MaximumPC.com下載鏈接，它看起來很好給我們。我們已經嘗試了使用兩個不同的帳戶在這裡兩台不同的機器，它已經罰款兩個帳戶（沒有雙關語意）。下面是我們使用的下載鏈接：http://dl.maximumpc.com/Archives/MPC0310-web.pdf。我們懷疑這是一個問題，你的讀者。嘗試使用Adobe Reader和看怎麼說了平移雅。

**(UNIVERSAL TRANSLATOR MODE ON)** We've tested the download link on MaximumPC.com and it looks fine to us. We've tried it on two different machines using two different accounts, and it's been fine on both accounts (no pun intended). Here is the download link we used: http://dl.maximumpc.com/Archives/MPC0310-web.pdf.

We suspect it is an issue with your reader. Try using the latest version of Adobe Reader and seeing how that pans out for ya.

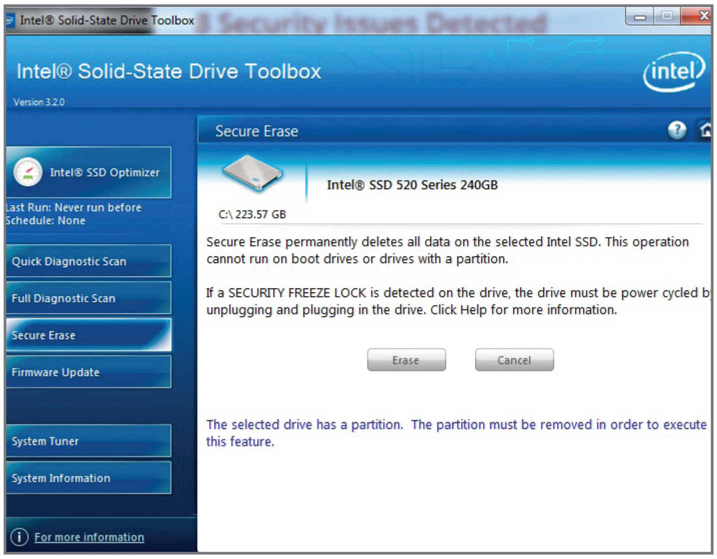
### Should I Nuke My SSD?

I know with a typical hard drive that information can be retrieved from it even after being over-written a number of times with new data. How about with an SSD? If a drive is returned to the manufacturer or sold, should a program like DBAN be used on it first?

**—Steve Nagy**

**SENIOR EDITOR JOSH NOREM RESPONDS:** That's a great question, Steve. Based on what we've read, SSDs are even more susceptible to this than hard drives, because the drive's wear-leveling routines will prevent a particular area of the drive from being written to over and over. Instead, the drive will just write to other NAND cells in an attempt to "wear level," which doesn't help much if you're trying to nuke a specific piece of data. Overall, it is very problematic to try to destroy a piece of data, so the best tactic is to attempt to wipe the entire drive, and just like with a hard drive, a

↘ submit your questions to: comments@maximumpc.com



Secure Erase permanently deletes all data on the selected Intel SSD. This operation cannot run on boot drives or drives with a partition.

If a SECURITY FREEZE LOCK is detected on the drive, the drive must be power cycled b unplugging and plugging in the drive. Click Help for more information.

The selected drive has a partition. The partition must be removed in order to execute this feature.

**A secure erase is the safest way to remove data from an SSD, but it's not foolproof.**

complete format will do very little to actually remove the data. Instead, you will need to perform a "secure erase" to nuke everything. If you have an Intel or Samsung drive, you can nuke it from the bundled software utilities. Otherwise, check out Parted Magic, which can "zero out" all the data on the drive. Also, be aware that writing data to the drive in this manner will reduce the lifespan of the drive, since NAND flash can only handle a finite number of writes before it becomes read-only.

## You Left Out Step 2.5

I recently bought my first SSD and was following the Fine-Tune Your SSD tips in the March 2014 issue. However, I ran into a big problem. When setting AHCI mode in my BIOS, Windows 7 would not boot. I reset it back to IDE and was able to boot and found the following instructions.

1) Run the Registry Editor (regedit.exe)
2) Navigate to Registry Key: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Msahci
3) Set the "Start" value to 0 (zero)
4) Navigate to Registry Key: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Pciide
5) Set the "Start" value to 0 (zero)
6) Shut down
7) Start up again, but before Windows boots, go into the BIOS configuration screens and change the disk mode to "AHCI".
8) Save the new BIOS configuration and restart, so that Windows boots.

When Windows starts, it will detect the change, load new disk drivers, and do one more reboot to start up with them. I thought this might be useful to other readers who might ran into the same issue.

**—Jim Holimon**

**[NOW ONLINE]**

## THE MOST GRAPHICALLY DEMANDING PC GAMES

If you're not playing the latest gut-wrenching games, you're not taking full advantage of your mighty rig. To help give your PC the proper workout it deserves, we've rounded up the most graphically demanding games we could find. Our methodology involved cranking these games to max settings to see which ones would make our graphics cards squeal the loudest. What are the most intensive games? Check out our story online to find out! http://bit.ly/mpcdemanding

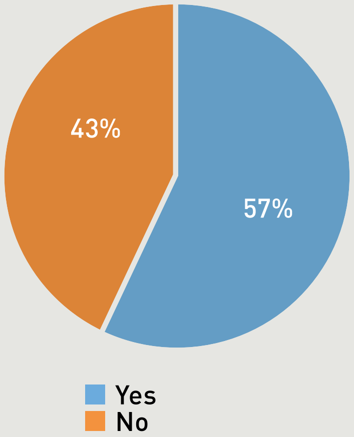
**Facebook Polls**

## What do you do when your computer starts to slow down?

In honor of this month's Clean Start issue, we asked our Facebook fans what is the first thing they would do if they noticed their PC beginning to chug. Our favorite answers are listed below.

**Robert Wiley:** Format, reinstall Windows. Now, to never download porn again.
**Chris Lemery:** Say "Thanks, Obama" then curl up naked in a corner and suck my thumb.
**Dean Phillpotts:** Overclock it more!
**Matthew Collette:** Remove AOL.
**Mike Stone:** This is a hypothetical because my computer never slows down.
**Jake Rudolph:** Download more RAM.
**C Ian Norrod:** Nuke it from orbit; it's the only way to be sure.
**Matt Bennett:** Remove Windows, install Linux :)
**Tammy Meadows:** I call my son Matt, the IT guy.
**Madison Nash:** First thing? Reboot!
**Byron Geils III:** Push the Turbo button.
**Kevin Anger:** Cuss and swear.
**Raheim Allen:** Take it out back, *Old Yeller* style.
**Rdm Renshaw:** Curse Bill Gates.
**Scott Powers:** Ask my wife what she's installed, and uninstall it.

## Would You Upgrade to Windows 8.1 if It Were Free?



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# THE BUILDS

## BUDGET

## BASELINE

### INGREDIENTS

| PART | | PRICE |
|---|---|---|
| **Case** | NZXT Source 210 Elite | $50 |
| **PSU** | Corsair CX500 500W **NEW** | $30 |
| **Mobo** | Biostar TA970 **NEW** | $80 |
| **CPU** | AMD FX-6300 | $110 |
| **Cooler** | Cooler Master Hyper 212 Evo | $35 |
| **GPU** | EVGA GeForce GTX 750 Ti 02G-P4-3753-KR **NEW** | $160 |
| **RAM** | 2x 4GB Kingston HyperX Black DDR3/1600 **NEW** | $65 |
| **SSD** | 120GB Kingston SSDNow V300 SV300S37A/120G **NEW** | $80 |
| **HDD** | Seagate Barracuda 1TB | $60 |
| **OS** | Windows 8 64-bit OEM | $100 |

**Approximate Price: $770**

### INGREDIENTS

| PART | | PRICE |
|---|---|---|
| **Case** | Corsair Vengeance C70 | $120 |
| **PSU** | XFX P1-750X-XXB9 750W **NEW** | $85 |
| **Mobo** | Gigabyte G1.Sniper Z87 **NEW** | $160 |
| **CPU** | Intel Core i5-4670K | $240 |
| **Cooler** | Cooler Master Hyper 212 Evo | $35 |
| **GPU** | EVGA GeForce GTX 760 02G-P4-3765-KR | $250 |
| **RAM** | 2x 4GB Kingston HyperX Black DDR3/1600 **NEW** | $65 |
| **Optical Drive** | Samsung SH-224DB/BEBE | $20 |
| **SSD** | Samsung 840 EVO 250GB **NEW** | $150 |
| **HDD** | Seagate Barracuda 1TB | $65 |
| **OS** | Windows 8 64-bit OEM | $100 |

**Approximate Price: $1,290**

**WE'RE STICKING** with AMD's hex-core FX-6300 CPU since it offers a good balance of price and performance, though Intel's 4th generation Core i3 chip is a fine alternative for tasks that aren't multithreaded. We've changed the motherboard, RAM, and power supply to address price fluctuations. The GeForce GTX 750 Ti replaces AMD's Radeon HD 7790 because the latter is discontinued, and AMD's alternatives, such as the Radeon R7 265, have not had stable pricing or widespread availability. The GTX 750 Ti is based on Nvidia's new "Maxwell" architecture, so it requires less than half the power of a comparable AMD card—it doesn't even use a PCI Express power cable. This EVGA version has high stock clock speeds and a swanky ACX-inspired cooler.

**THIS TIER IS** where we loosen the purse strings and crank up performance. We've changed the PSU from a Thermaltake Smart-M to reflect some price fluctuations. This XFX unit is also made by Sea-Sonic, which has a good rep and makes units for Corsair and Antec. The GeForce GTX 760 is still king at this price point, and the EVGA ACX model has upgraded clock speeds and cooling. We've changed the RAM from G.Skill Ares because the Kingston Black sticks were on sale and have solid reviews. We've changed the SSD from a Crucial M500 to a Samsung 840 EVO to take advantage of the latter's higher performance, caching, and slick "Magician" software. The motherboard is once again the Gigabyte Sniper Z87, because it has high-quality integrated sound for the price.

## PERFORMANCE

### INGREDIENTS

| PART | | PRICE |
|---|---|---|
| **Case** | NZXT Phantom 530 | $130 |
| **PSU** | XFX P1-850B-BEFX 850W **NEW** | $126 |
| **Mobo** | Asus Sabertooth X79 | $320 |
| **CPU** | Intel Core i7-4820K | $305 |
| **Cooler** | NZXT Kraken X60 | $120 |
| **GPU** | EVGA GeForce GTX 780 03G-P4-3784-KR | $500 |
| **RAM** | 4x 4GB G.SKILL Ripjaws F3 12800CL9Q-16GBRL **NEW** | $150 |
| **Optical Drive** | Asus BW-12B1ST | $60 |
| **SSD** | Samsung 840 EVO 500GB | $280 |
| **HDD** | Seagate Barracuda 3TB | $110 |
| **OS** | Windows 8 64-bit OEM | $100 |

**Approximate Price: $2,220**

**THIS TIER IS** optimized for a rig that will eventually have multiple GPUs, so while the previous build's LGA 1150 motherboard has the slots, you need an LGA 2011 setup to avoid SLI bottlenecks. To that end, we're running a high-octane PSU with six six-pin PCIe cables, so it supports up to three GPUs. The Corsair HX850 it replaces is a decent unit, but its price shot back up recently.

We considered the Corsair 750D case, but the design of the Phantom 530's top allows it to fit a wider variety of radiators, its drive trays feel more durable, and its larger fans allow for quieter operation. Corsair has some new cases coming out soon though, so we'll certainly revisit this.

We confirmed in this month's Build It that the Asus X79 Deluxe can handle three GPUs with ease. It works best with four or eight sticks of RAM, and these G.Skill Ripjaws were moderately priced. The Kraken X60 cooler is powerful yet quiet, and the Asus BW-12B1ST lets us burn and play Blu-rays.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

## UPGRADE OF THE MONTH

## ARCTIC COOLING F12 PWM CO 120MM CASE FAN

ARCTIC
F12 PWM CO

Even the best cases could use a fan upgrade, so this month we're highlighting Arctic Cooling's F12 PWM CO 120mm case fan. It's rated to run 24/7, is temperature-controlled, quiet, relatively inexpensive, and sports a six-year warranty. We used its 140mm cousin in last year's Dream Machine. And black goes with everything. **$13, www.arctic-cooling.com**

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